2025 ACS Surgical Simulation Summit

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ABSTRACTS

Table of Contents

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ABSTRACTS

This document contains all abstracts that were presented as a scientific paper or poster at the 2025 ACS Surgical Simulation Summit.

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Papers Session I: Completed Research

AI-Driven Prediction of Errors in the Advanced Training in Laparoscopic Suturing (ATLAS) Needle Handling Task: One Step Closer to Automated Surgical Skill Assessment

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INTRODUCTION: To teach laparoscopic knot-tying and suturing skills, the Advanced Training in Laparoscopic Suturing (ATLAS), a six-task proficiency-based curriculum was introduced. The Needle Handling task requires needle maneuvering through six holes on a circular platform. Performance is evaluated through video review for completion time and errors, such as "needle drop". This study aims to develop an AI-driven automated assessment model to predict "needle drop" error, defined as needle dropped outside the field of view longer than 5 seconds.

METHODS: This study involved a retrospective review of ATLAS task 1 videos collected from a tertiary center. Frames were extracted, and 100 images were randomly selected from each video. Each image was then divided into 9 parts, with each annotated as 1 or 0, depending on whether the needle was present. If the needle appeared in view, it was considered visible in the view. A Vision Transformer (ViT) was trained using annotated images for the detection of needle drops.

RESULTS: Out of 606 images extracted, 482 were used for training, while the remaining 124 were used for validation. The accuracy of the ViT model for the classification task was 95.16%. The model performance was then tested on a new set of videos, which was not part of the training for detection of needle drops. The model correctly detected the instances of needle drop of more than 2 seconds, 12 out of 18 occurrences (66.6%). For instances of 5 seconds or more, it correctly predicted 7 out of 11 occurrences (63.6%).

CONCLUSION: The AI model was able to automatically detect needle drop errors with moderate accuracy. We plan to improve the accuracy of the detection by collecting more training and test videos of Task 1. We will incorporate our model for automated skills assessment and real-time feedback within the ATLAS curriculum.

Multiyear Analysis of the Impact of Fresh Tissue Training (FTT) for General Surgery Residents' Trauma Education

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INTRODUCTION: Due to fundamental shifts in operative trauma cases, cohorts of general surgery residents (GSR) are at risk of completing training with deficiencies in open surgery skills. Along with paradigm shifts in operative trauma management, the implementation of duty-hour restrictions has been associated with declines in the volume of operative trauma cases. These deviations pose a severe risk to GSR for developing a deficiency in the technical skills required for life-saving interventions.

METHODS: Fresh, untreated cadavers were cannulated in the femoral artery and linked with a pump that supplied the vasculature with fake blood. GSR practiced the following technical skills under simulated perfusion: neck exploration, left anterolateral thoracotomy, trauma laparotomy, and fasciotomies of the lower extremities (LE). Before the simulation, GSR would complete a fifteen-question conventional exam and a four-point Likert scale confidence survey (CS). A modified four-point Zwisch scoring system assessed their technical performance during the simulation. Data was compiled from the last five years' GSR cohorts and analyzed in JMP Pro (2024).

RESULTS: GSR reported a significant increase in their score from their pre- and post-simulation conventional exams with an average of 70.23 ±15.35 and 75.56±13.33, respectively ($p<0.05$). A similar increase was noted between the pre-and post-simulation CS survey scores, with an average score of 16.06 ±11.98 and 31.71±8.36, respectively ($p<0.001$). When comparing technical performance, there was a significant disparity in mean performance in the neck (10.78±1.93) vs the abdomen (22.44±4.65), chest (19.8±7.49), and the LE (26.21±9.13) ($p<0.001$). Finally, a strong correlation was noted between technical performance in the neck and the chest ($R2=0.90$).

CONCLUSION: This study demonstrates that high-fidelity perfuse cadavers can enhance the training of GSR from technical, psychological, and knowledge acquisition standpoints. Future studies will need to investigate the translational capability of FTT by tracking similar metrics supplemented with physiological data in actual cases.

A Call for Institution-Wide Simulation: A GME, Trauma, and Simulation Center Collaboration Utilizing Video Review and In-Situ Simulation

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INTRODUCTION: Multi-disciplinary team simulation has been shown to limit medical errors, improve standard of care and decrease physician burnout. Trauma video review (TVR) can enhance simulation and provide objective feedback. In this novel collaboration with the institutional Graduate Medical Education (GME), we implemented trauma simulation training and reviewed audiovisual recordings to meet GME core competencies and expectations for institution-wide simulation.

METHODS: This was a prospective observational trial comparing non-technical performance before and after roll-out of a teamwork-focused training (TeamSTEPPS). Three pre-intervention trauma simulations were held followed by a one-hour TeamSTEPPS instruction to all surgical residents. Four in-situ post-intervention trauma simulations using high-fidelity manikins were held in the trauma bay, including a five-minute refresher with role play, followed by the trauma simulation. Performative analysis (participant survey and non-participant TVR) was provided utilizing the T-NOTECHS (non-technical skills scale for trauma, revised), with lower scores reflecting better performance.

RESULTS: Over the span of 7 months, there were a total of 142 participants; 33 (23.2%) were designated as active participants, while the other 109 (76.8%) were in the observer role. Participants represented a multi-disciplinary team including 81 residents (57.0%), 11 nurses (7.7%), 16 faculty members (11.3%), 7 identifying as 'other' (4.9%) and 8 unspecified (5.6%). Overall, the post-intervention analysis of participants after TeamSTEPPS training improved; significant improvement was observed in Cooperation & Resource Management (participant evaluation & TVR analyses) and Communication (TVR analyses).

CONCLUSION: To our knowledge this is the first combined TVR and participant-based review of trauma simulation utilizing the TeamSTEPPS framework. We found improvement in all categories pre and post implementation, particularly in Communication and Cooperation and Resource Management. TVR allows for objective assessment and feedback and is a critical part of trauma simulation. Next steps include integration of TeamSTEPPS into every department's simulation activity to improve non-technical skills.

Plant-Based Biodegradable 3D-Printed Laparoscopic Training Kit

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INTRODUCTION: In recent years, the advantages of medical simulators have become increasingly evident, particularly in the enhancement of education and surgical skills. However, such simulators are often quite expensive, large, need specialized maintenance, and have limited global accessibility. In our study we aimed to develop a surgical simulator, that is affordable, compact and whose design and modules can be shared between institutions though software, requiring only a 3D printer for production, while also ensuring sustainability and environmental friendliness.

METHODS: We used Dassault Systems SolidWorks in order to design 35x25x25cm laparoscopic training box, a pegboard and 35x0.5cm laparoscopic graspers, using plant-based biodegradable PLA and printed via an EOS EOSINT P 390 and a SOVOL SV01 PRO 3D printers. The top panel was designed with 4 instrument access points and a phone mount for easier accessibility. The laparoscopic graspers were printed in 7 pieces and assembled. The pegboard was designed with 10 peg post ports to allow for different peg post configuration and different post designs. The pegs were made from silicone rubber. In our study we used 12 medical students and 2 residents who trained and were evaluated with a 6-peg configuration according to the SAGES FLS exam.

RESULTS: The total cost for producing all the equipment amounted to 14,5USD and total time for printing amounted to 25 hours and 1 hour for assembly. The participants reported satisfaction with our simulator and had a significant reduction in time and errors, with continuous training.

CONCLUSION: The significantly lower cost of our simulator offers our institutions a financial and environmentally sustainable alternative for laparoscopic training, allowing the development of different modules and designs, further enhancing medical training.

Simulation-Based Training Reduces Unnecessary Ultrasound Referrals for Developmental Hip Dysplasia in Newborns

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INTRODUCTION: Developmental dysplasia of the hip (DDH) is a common newborn condition with malformation or instability of the hip joint. Identifying DDH early is imperative for avoiding long-term physiologic consequences. In the United States, newborn clinical examination includes DDH screening protocols that employ Ortolani and Barlow maneuvers. Evidence suggests that insufficient training practices for the Ortolani and Barlow exam techniques may be leading to unnecessary imaging referrals for further assessment. We investigated the impact of a DDH simulator (MiHip model) and training program on ultrasound referral rates at one institution.

METHODS: From July 2021 to June 2022, 54 residents on newborn rotations participated in simulation-based training with the MiHip model. All newborns born at our institution one year prior (n=5,404) and one-year post-training period (n=5,792) were identified. High-risk factors that automatically result in ultrasound referrals (family history of DDH, breech presentation, and multiple births) were excluded. Following chart analysis of the remaining 9,856 newborns, a Chi-square goodness of fit test was used to compare pre- and post-training incidences of both DDH-relevant referrals and unnecessary (defined as DDH negative) ultrasound referrals. $p \leq 0.05$ was considered statistically significant, and effect, $\omega \geq 0.14$ considered large.

RESULTS: Following training, initial referral rates for DDH decreased by 34.07% with a χ^2 (1, N = 5031) = 34.41, p = 0.02 and ω = 0.08. Unnecessary referrals were reduced by 23% with a χ^2 (1, N = 33) = 17.96, p = 0.04 and ω = 0.74.

CONCLUSION: The MiHip curriculum significantly reduced the rate of unnecessary ultrasound referrals, highlighting the benefits of simulation-based training for DDH examination skills. This training could reduce financial and emotional burdens associated with unnecessary imaging, specialist consultations, and follow-up appointments. Future studies will explore the impact of this training on patient outcomes, cost, and refining DDH screening.

Longitudinal Evaluation of a Surgical Simulation-Based Curriculum for Medical Student Education in Rwanda

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INTRODUCTION: Simulation-based training is a valuable tool for medical education but is often inaccessible in low-resource settings. We evaluated the longitudinal impact of a surgical simulation curriculum we developed and implemented for junior medical students in Rwanda, prior to their clerkships in district hospitals.

METHODS: We surveyed senior medical students one year after they completed the one-week simulation curriculum to assess its relevance and impact on their medical education and career choices. We utilized inductive qualitative thematic analysis for free text responses.

RESULTS: We received 34 completed surveys out of 66 (52%). Almost all students (32/34;94%) reported increased confidence in clinical skills after participating in the surgical simulation week with an average increase of 2.31 on a 5-point Likert scale. All students reported using the skills learned in their clerkships. Themes that emerged from qualitative analysis included the value of hands-on practice, and the relevance of the skills in their surgical clerkship. Students highlighted suturing and knot tying practice as most valuable because these were "commonly used in the hospital" and found that "it is hard to get time to learn it on rotations". For future training, they recommended additional time to practice skills, more wound care modules, WHO handwashing, chest tube insertion, and how to improvise in a resource-limited setting. Fourteen students (41%) reported an interest in pursuing surgery or a surgical subspecialty with six (18%) stating the simulation week impacted their decision. Over half the students (55%) expressed interest in contributing to the evaluation of the simulation-based curriculum.

CONCLUSION: Medical students found the skills taught during a one-week surgical simulation curriculum valuable during their clerkship. Students expressed interest in engaging in medical education research, which presents an opportunity to increase equity and representation in global surgery research and education.

Papers Session II: In-Progress Research

Intraoperative Code Status: Moving from Misinformation to Respect for Patient Autonomy

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INTRODUCTION: Intraoperative code status represents a complicated topic for patients and providers. Prior studies demonstrated a lack of understanding of intraoperative code status, specifically do not resuscitate (DNR) orders. This misunderstanding appears common despite clear professional recommendations. A recent survey of surgery residents at our institution showed variability in understanding of intraoperative code status policy despite clear institutional guidelines. Few studies utilized simulated education for surgeons and surgical residents to navigate intraoperative DNR status. This project aims to create a simulation-based program for residents to navigate intraoperative DNR status ethically and to assess its impact on learning, practice patterns and hospital outcomes.

METHODS: Surgery residents will be invited to participate in simulation-based training on discussing intraoperative code status. The simulation will include a patient who will request intraoperative continuation of DNR status. Following the encounter, residents will debrief with critical-care surgeons and a clinical ethicist. The Gather, Analyze, Summarize framework will guide debriefing. A slideshow of key points and references, including relevant hospital policy, will facilitate the debrief.

RESULTS: A simulation scenario was created in which residents will address 7 learning objectives. Two critical-care surgeons and a clinical ethicist at our institution reviewed these objectives, which will form the basis for the debrief. The objectives were also used to guide the development of a 7-item post-training survey, which will help determine the immediate effectiveness of this simulation.

CONCLUSION: This simulation was created to meet the need for clear discussion of intraoperative DNR policy and navigation of difficult conversations while respecting autonomy. Next steps will focus on implementation of this training and evaluation of its effectiveness. Effectiveness will be evaluated using the first four levels of Kirkpatrick's model. Learning will be assessed using the 7-item post-training survey, while changes in practice patterns will be assessed via a six-month follow-up survey.

Spinal Support Harness for Surgeons: Enhancing Ergonomics in the OR

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INTRODUCTION: In the last 20 years the prevalence of degenerative cervical spine disease (DCSD) and degenerative lumbar spine disease (DLSD) among doctors, increased by 18% and 27%, while 17% of surgeons suffer from DCSD and 19% from DLSD, leading to burnout and premature retirement. Recent publications demonstrated that occupational injury costs hospitals $190 billion in liability and lost income, and $100 billion in treatment of these injuries, annually.

In our study we developed a spinal support harness prototype, that is compact, affordable, wearable in the OR and provides a significant reduction on the strain in the lower back.

METHODS: Our conceptual design focused on transferring the weight bearing from the lower-back, to the feet. For physical prototyping we used a shoulder back harness, ankle straps, 2.08m 25N/m rubber band made of 50% synthetic rubber and 50% natural latex, 80x8mm steel carabiners and 50mm metal D-rings. All components were purchased individually, modified and assembled into a spinal support harness. The shoulder-back harness was connected via rubber bands to ankle straps, designed to be worn on the back and comfortably fit under surgical scrubs. The device was tested by 4 surgeons suffering from lower-back pain, over a 30-day period. The rubber bands were adjusted according to the height of the surgeons to ensure proper support.

RESULTS: Total cost amounted to 50.04USD/device. Preliminary data indicated high satisfaction among the surgeons testing the device, reporting significant lower-back pain reduction. Additionally, the ability to maintain a slightly inclined position throughout the operation, contributed to a reduction in cervical pain associated with a straight neck posture. The device was well-tolerated and demonstrated a high level of comfort and movement during use.

CONCLUSION: The low cost, ease of production, comfort, and suitability for use in the OR make our device a strong candidate for enhancing surgical ergonomics.

A Thematic Analysis of Communication Patterns of Interprofessional Teams during Simulated Pediatric Traumas

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INTRODUCTION: Pediatric trauma care requires complex coordination and rapid, accurate actions in high-stakes situations by ad hoc interprofessional (IP) teams. This teamwork is driven by human interactions and institutional culture (1), which are difficult constructs to measure. Simulated pediatric traumas offer opportunities to observe team communication practices, understand the landscape of team communications, and explore relations to simulated patient endpoints. We hypothesize that observing 12 IP in situ simulations will allow us to identify and categorize IP team communications practices. Data will be collected through observational field notes, psychological safety self-reports [2, 3], structured debriefing notes, and semi-structured interviews. Findings can provide the background context to inform systematic assessment of communication practices and inform future translational simulation studies into the impact of IP team communications on patient care.

METHODS: We utilized recursive thematic analysis (RTA; 4) to analyze qualitative data on IP team communications. Specific RTA elements included:

1. Data familiarization
2. Generation of codes relevant to IP communications
3. Theme development
4. Refinement of themes and member checking processes
5. Re-application of themes and generation of quantitative descriptive data

RESULTS: We are currently tagging instances of these themes in all cases, including positive and negative examples. This will allow us to provide quantitative data on observed theme frequency and make connections to anticipated simulated patient endpoints.

CONCLUSION: Data collection has been completed and themes have been developed and refined through the RTA process. Data analysis to generate frequencies of observed themes across the 12 observed scenarios continues. Associations among IP communication types and anticipated simulated patient endpoints will be analyzed. This preliminary investigation may provide foundational information that can be used in larger systematic assessments of communication patterns and can inform translational team training.

Exploring Risks of Failure in Advanced Trauma Life Support Courses

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INTRODUCTION: The 10th edition of the Advanced Trauma Life Support Course (ATLS) offered a hybrid course where didactics were completed prior to attending the in-person portion. This resulted in less interaction between students and instructors and anecdotally hindered identifying students at risk of failure. Identifying these students earlier may allow for overall performance improvement.

METHODS: ATLS course data for hybrid student and refresher courses taught in 2023 from a single state committee on trauma were included. Students' training status, specialty, pre- and post-test scores, and home institution were recorded. Nine were medical students and excluded from analysis. At-risk of failing was defined as a post-test score of ≤77.5% on the written examination. Proportions at-risk were compared by predictor using the chi-squared test. Pre-test scores were compared between students using the Mann-Whitney U test. Predictors of at-risk performance were compared using logistic regression.

RESULTS: Among 569 students in the study, 100 were at risk of failure. The proportion at-risk was higher for hybrid courses compared to refresher courses (24% versus 6%, $p<0.01$). The proportion at-risk differed by level of training (7% for attendings versus 26% for residents, $p<0.01$) and by specialty among attending physicians (2% for surgical versus 8% for emergency medicine versus 25% for others, $p=0.02$). At-risk students had lower pre-test scores. In adjusted analysis, status as an attending surgeon (OR = 0.08, $p = 0.02$) and pre-test score (OR = 0.97 per additional point, $p < 0.01$) were associated with lower odds of an at-risk score.

CONCLUSION: Among ATLS course trainees, status as a surgical specialty attending physician, higher pre-test score, and refresher course format were associated with lower odds of an at-risk final score. Future work is needed to identify and support at-risk students in hybrid ATLS courses.

High Superficial Resemblance vs. High Functional Task Alignment Simulation for Central Venous Catheterization Training: A Randomized Crossover Study

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INTRODUCTION: Fidelity in procedural skills simulation can be classified as superficial resemblance (simulator approximates real tissue) and functional task alignment (FTA; key steps of simulation approximate those of real procedure). We hypothesized that resident physicians would prefer a simulation model with high FTA over a model with lower FTA and higher superficial resemblance, in the context of training for central venous catheter placement.

METHODS: We conducted a randomized crossover trial, enrolling residents from Surgery, Anesthesia, Emergency Medicine, and Pulmonary and Critical Care Medicine. We compared a commercial model with high superficial resemblance and low FTA vs a custom model with high FTA and lower superficial resemblance. Participants used each model once (crossover), with sequence randomly assigned. After using each model, they used a 5-point scale to rate superficial resemblance (ultrasound image, tissue feel, needle and transducer functionality, model as a whole) and FTA (movements, steps sequence, continuity between steps, task as a whole). Finally, participants rated their preference in a final questionnaire after using both simulators.

RESULTS: Thirty residents participated. There were no statistically significant differences between models for the sub-features of superficial resemblance, but "model as a whole" was rated higher for the custom model ($p=0.007$). Two sub-features of FTA and "task as a whole" were rated higher for the custom model ($p \leq 0.03$). Participants, definitely (N=12) or probably (N=12), preferred the custom model for future training (total 80% preferred the custom model); only 6 (20%) preferred the commercial model.

CONCLUSION: Resident physicians rated the custom simulator higher for both overall superficial resemblance and for most measures of FTA, and preferred this model overall, in comparison with the commercial simulator. Recruitment is ongoing.

Two Is Better than One: Modeling Multicompartmental Hemorrhage for Penetrating Polytrauma Simulation in an Ultra High Fidelity Knowledge Donor Model

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INTRODUCTION: While single extremity or single vessel bleeding modeling has been described in cadaveric operative simulation, real world penetrating trauma often requires management of complex multi-compartmental hemorrhage.

This study describes a multicompartmental hemorrhage model developed on an ultra-high-fidelity whole-body donor based cadaveric platform known as Knowledge Donor, avoiding native anatomic incisions needed by the learner for proximal control. Utilizing this proof-of-concept bleeding simulation, surgical trainees underwent polytrauma operative scenarios and were surveyed for perception of simulation quality and impact on procedural confidence.

METHODS: Deceased whole-body donors preserved with an advanced solution that maintains visual and tactile tissue quality, perfused with expired human packed red blood cells and mechanically ventilated, were used. Three preparatory surgical incisions were made; a retroperitoneal flank incision accessing the iliac vessels, a suprageniculate incision to create a mid-superficial femoral artery injury, and a contralateral groin incision to create a retrograde iliac vein injury. Surgical trainees then participated in penetrating operative polytrauma scenarios and perception, and confidence surveys were collected.

RESULTS: Surgical residents felt that the enhanced bleeding model demonstrated high realism across multiple qualitative parameters. Mean scores were 8.3/10 for appearance, 7.3 for elasticity, and 7.3 for turgor. Notably, 73% of participants did not observe significant tissue edema, with the comparison to live tissue scoring 7.3/10. 41.7% of residents felt they required direct supervision for the procedures pre-training, decreasing to 25% post-training. Conversely, those feeling capable with indirect supervision increased from 41.7% to 58.3% after training.

CONCLUSION: Initial perception results in this novel hemorrhage model demonstrate close correlation with live patient tissue experience, and training demonstrated improvement in learner confidence. The Knowledge Donor platform creates novel opportunities for simulating complex multicompartmental hemorrhage requiring operative management decisions mimicking challenging real-world conditions.

Meet the Authors Poster Session

Curriculum Development, Posters 1–14

Poster #1

PGY2 Surgical Olympics Improved Resident Confidence for Common Trauma and ICU Tasks

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INTRODUCTION: The second post-graduate year (PGY2) of surgical residency classically consists of multiple ICU and trauma rotations. Resident preparedness for these rotations is variable; thus we developed a focused simulation assessment titled the "Surgical Olympics" for rising PGY2s involving common trauma and ICU procedures. It was hypothesized this single simulation session would improve resident confidence.

METHODS: The Surgical Olympics (SO) consists of 5 tasks: chest tube placement, cricothyroidotomy, arterial line placement, FAST exam, and a breaking bad news communication station. Rising PGY2s in general, plastics, and vascular surgery participated, and all were sent instructional materials in advance. At the SO, residents performed each task without coaching and their technique was scored using an objective 0-10 scale. After task completion, residents were given personalized feedback and instruction. All participants completed anonymous surveys before and after the SO, including evaluating their task confidence utilizing a 1-5 Likert scale (5=most confident). Pre- and post-scores were compared using a paired t-test.

RESULTS: SO has been performed twice (2023,2024), with a total of 20 residents participating. Prior to the SO, 50% of participants had placed a chest tube, 10% performed cricothyroidotomy, 35% placed arterial lines, 10% performed FAST exams, and 70% had broken bad news. The majority of more residents were not confident in performing these tasks, except for breaking bad news. After the SO, confidence scores improved for all tasks (chest tube average increase of 0.95, $p<0.01$, cricothyroidotomy +0.95, $p<0.01$, arterial line +0.85, $p<0.01$, FAST exam +0.65, $p=0.03$, bad news +0.84, $p<0.01$). Objective task scores were not correlated with confidence scores (all $R^2<0.2$).

CONCLUSION: SO is a simple series of simulations that assessed rising PGY2 residents on common ICU and trauma tasks. It improved self-reported confidence for all assessed items. The impact of this simulation on clinical performance is unknown.

Poster #2

Comparison of Prior Disaster Preparedness Training and Simulation among Incoming Interns at an Academic Medical Center in 2024 vs. 2010

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INTRODUCTION: In the past thirty years there have been numerous natural and man-made disasters including the 1995 Tokyo sarin attack, 2001 World Trade Center and Pentagon attacks, 2011 Fukushima nuclear accident, 2017 Las Vegas mass shooting, and 2020 COVID-19 pandemic. Despite this, there is no national consensus on a disaster preparedness curriculum for medical students. Surveys have shown that healthcare providers do not feel well prepared for a disaster. We designed a survey to assess prior disaster preparedness training in medical school, including simulation, among all the 2024 incoming interns at our academic teaching hospital. We previously assessed the same data in 2010 and compared the two data sets.

METHODS: All 129 incoming interns representing 6 residency programs were surveyed in 2010 regarding number of hours of training received during medical school in disaster preparedness. Further, they were asked if any simulation was utilized for this training and their level of self-perceived proficiency in disaster management. The same survey was administered to the 131 incoming interns in 2024.

RESULTS: Only 28 percent of the interns received any formal training in disaster preparedness in medical school in 2024, compared to 47 percent in 2010. Of those, 35 percent included some type of simulation in 2024 compared to 64 percent in 2010. An average of 2.00 total hours were spent on disaster preparedness training in 2024 compared to 2.18 hours in 2010. Mean 5-point Likert scale responses for self-assessed level of proficiency in disaster preparedness was just 1.72 in 2024 and 1.93 in 2010.

CONCLUSION: There is clearly a need to improve disaster preparedness training in medical school. Our data shows that this training decreased from 2010 to 2024. A national curriculum should be developed that includes aspects that promote knowledge retention, such as hands on and case-based training, and advanced simulation.

Poster #3

A Surgical Intensive Care Simulation Curriculum for Residents

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INTRODUCTION: Clinical care experience is not a universal requirement in medical school and thus residency may be the first time trainees are tasked with caring for critically ill patients. The intensive care unit presents challenges to learning due to the high acuity of patients, the variability in patient conditions, and unpredictable clinical schedule. Our goal was to implement a simulation curriculum for residents on their surgical critical care rotation to improve knowledge and comfort in managing common critical care conditions.

METHODS: Six simulation cases were created based on a previously completed needs assessment. Clinical case topics included TBI, cardiac tamponade after cardiac surgery, respiratory failure, SVT, septic shock/adrenal insufficiency, and bradycardia. Each session lasted an hour with the sim scenario taking place for 15 minutes and the remainder of the hour available for debriefing. Sim sessions took place twice per month. Residents who participated were from general surgery, anesthesia, and surgical subspecialties. Residents were surveyed on the learning environment and their acquisition of new skills and knowledge on a 5-point Likert scale.

RESULTS: Over the course of 1 year there were 42 residents who participated in the simulation sessions. Residents felt the format was conducive to learning (mean score 4.83) and the session was structured in an organized way (mean score 4.92). Residents reported they learned new skills (mean score 4.54) and felt comfortable developing a differential diagnosis, performing a clinical workup, and initiating a treatment plan for a variety of conditions. Residents reported that the debriefing sessions helped establish an engaging learning environment and facilitated discussions where everyone could be heard.

CONCLUSION: We successfully implemented a surgical critical care simulation curriculum for residents and improved resident confidence in managing critical care conditions. Residents felt a strength of our curriculum was the significant time allotted to debriefing.

Poster #4

Mitigating Training Gaps in Disrupted Healthcare Systems: A Drill-Based Approach to Upskilling Emergency and Trauma Surgical Capabilities

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INTRODUCTION: Healthcare systems are vulnerable to major disruptions (e.g. armed conflict, cybersecurity attacks or climate-related disasters) that have detrimental effects on surgical training. This requires rapid upskilling of the surgical workforce, which typically has limited trauma, emergency or humanitarian operative experience. Drill-based training (DBT) provides competency-based skill acquisition using a series of memorized priority actions focused on managing specific, safety-critical problems. This study investigates the acceptability, feasibility and content validity of cadaveric DBT in training trauma-naïve surgical residents.

METHODS: General surgery trainees emerging from the COVID-19 pandemic (2021-2022) enrolled in a one-day DBT programme. The curriculum addressed emergency procedures demanding technical autonomy with limited supervision - 'day-one ready' competencies (e.g. surgical airway or resuscitative thoracotomy). Pre- and post-course experience, knowledge, and procedural confidence were determined using quantitative self-reported questionnaires. Statistical analyses, including Wilcoxon rank-sum and chi-square tests, analyzed the course's educational impact. Cost-feasibility analysis used a sum-of-the-components approach.

RESULTS: Seventy-six participants completed DBT, with 89% (n=68) returning self-reported questionnaires. Pre-course critical skills exposure was limited, with the median number of observed, simulated, and performed procedures being <=1 for surgical airway, thoracotomy and limb fasciotomy. Following DBT, trainee-reported knowledge and confidence increased significantly across all skill domains. Median knowledge scores improved from 3 to 5 across all procedures ($p<0.001$). Confidence augmentation occurred in all skills stations ($p<0.001$), with the greatest improvement seen in thoracotomy (median=3, $p<0.001$). A positive impact on clinical practice was reported by 90% of participants. Health economics analysis identified a cost of £757 per participant. Cost-feasibility analysis demonstrated better or similar financial performance compared to existing courses.

CONCLUSION: DBT improves self-reported knowledge and confidence in key emergency and trauma interventions. This provides opportunities for rapid upskilling and expansion of surgical capabilities. DBT may mitigate future training vulnerabilities in disrupted healthcare systems.

Poster #5

Development of an Annual Laparoscopic Simulation Bootcamp and Assessment of Efficacy

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INTRODUCTION: As general surgery residents' roles and responsibilities evolve each postgraduate year, they must continuously work to advance their laparoscopic skills accordingly. We aimed to develop a laparoscopic simulation bootcamp as an annual, training level-specific curriculum with simultaneous analysis of resident perceptions regarding laparoscopic surgery and related simulation.

METHODS: The bootcamp curriculum featured eight, 2-hour laparoscopic simulation sessions hosted over two months and separated by post-graduate year (PGY). PGY 1 and 2 residents practiced Fundamentals of Laparoscopic Surgery (FLS) tasks and camera manipulation. PGY 3 through 5 residents trained procedure-specific laparoscopic skills in wet lab. All participating residents were surveyed prior to the curriculum's start to assess attitudes toward laparoscopic simulation and confidence participating in laparoscopic procedures. By the conference, we will have post-bootcamp survey data to evaluate changes in residents' perception of and confidence with performing laparoscopic surgery.

RESULTS: All pre-bootcamp survey respondents felt that the ability to operate laparoscopically was important to their future practice and 85% agreed that skills developed in simulation translated to the operating room. Among PGY 2 and 3 residents, all felt adequately prepared to operate as a laparoscopic first assist, but only 28% felt comfortable operating laparoscopically as a surgeon junior or chief. Compared to junior residents, PGY 4 and 5 residents felt more prepared to operate laparoscopically as surgeon juniors or chiefs (71%).

CONCLUSION: Residents who participated in the bootcamp will be re-surveyed 3 months following curriculum completion. The post-course questionnaire will focus on changes in confidence performing laparoscopic skills, perceptions of curriculum efficacy, and applicability of the curriculum to real-world skills. We anticipate that survey responses will identify preferred curricular components for skill acquisition and practice which may alter the training duration or structure of our laparoscopic bootcamp curriculum.

Poster #6

Redesigning a Laparoscopic Simulation Curriculum: A Program Review and Needs Assessment

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INTRODUCTION: Although the importance and relevance of simulation in laparoscopic surgical training has previously been well-demonstrated, voluntary training curricula are often ineffective for skill acquisition. Herein, we identified common themes in laparoscopic simulation programs with subsequent characterization of our own residents' perceptions of ideal training components and barriers to curriculum participation.

METHODS: A two-pronged approach was employed to identify areas of improvement for the laparoscopic simulation curriculum at a single institution. Simulation programs from select American College of Surgeons Accredited Education Institutes (ACS-AEI) were reviewed to distinguish common practices. Then, postgraduate year (PGY) 2-5 residents at the study institution were surveyed regarding attitudes and barriers towards the existing laparoscopic simulation curriculum.

RESULTS: Simulation frequency at institutions with ACS-AEI designation ranged from weekly to monthly. Many programs employed annual skill competitions for residents to encourage independent practice. While 78% of surveyed residents at the study institution felt that performance goals would motivate participation in simulation activities, only 50% felt similarly about laparoscopic skill competitions. Most residents (64%) reported a lack of defined laparoscopic simulation checkpoints per PGY level as a barrier to laparoscopic skill proficiency. Additionally, all PGY 2 and 3 residents identified the low frequency of simulation sessions as a barrier.

CONCLUSION: Review of existing laparoscopic training curricula demonstrates heterogeneity in training frequency but a common emphasis on skill competitions. Our institutional results demonstrate a need for curriculum design focusing on PGY-specific training checkpoints for residents and increased simulation frequency. Moving forward, we plan to explore gamification over competition in laparoscopic simulation training as well as employing a Delphi process with institutional laparoscopic experts to identify key training objectives for residents per PGY level.

Poster #7

Development of Common Bile Duct Exploration Simulation Curriculum to Equip Trainees for Rural General Surgery Practice

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INTRODUCTION: A key public health issue is access to surgical care, particularly in rural settings. Lack of broad scopes of training and pursuit of fellowship sub-specialization contribute to the rural surgeon shortage. Access to specialists across different disciplines of medicine is common at training programs, changing the scope of the experience for surgical trainees. One example is the laparoscopic common bile duct exploration (LCBDE). In a rural setting where ERCP proceduralists may not be available, LCBDE is a necessary tool to improve timely access to care. With a rural surgery emphasis, we sought to identify residency training gaps to address in our simulation curriculum.

METHODS: Mixed methods needs assessment was performed. A systematic search including PubMed, NLM, Scopus, and ScienceDirect was performed on performance of Laparoscopic Common Bile Duct Exploration and training gaps. Articles specifically addressing simulation-based education were also identified. An institution-specific needs assessment was performed surveying 72 critical procedures from both resident and attending perspectives (attending survey ongoing).

RESULTS: Literature search revealed common reasons for not performing LCBDE including availability of ERCP proceduralist and comfort level. Of 72 procedures on institutional survey, IOC was one of only 15 items with a mean rating less than 4 by PGY5 residents (4= fairly confident in performing the task independently). 85% of respondents performed 5 or less IOCs during training to date.

CONCLUSION: IOC is a critical step to assessing the duct and decision-making prior to LCBDE; however, it is not routinely performed at our institution leading to lack of resident confidence. After demonstrating need for improved exposure to IOC and LCBDE, we will incorporate IOC and LCBDE simulation in our curriculum and survey perceived confidence in performing IOC and LCBDE following implementation.

Poster #8

Robotic Operative Exposure Influences the Lasting Effects of a Resident Robotic Surgery Curriculum on Residents' Confidence and Perceived Skills

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INTRODUCTION: Residency programs are implementing robotic curriculums. It was hypothesized that the long-term impact on residents' robotic skills is influenced by variability in exposure and independence during subsequent robotic operations throughout residency.

METHODS: PGY-3 residents completed a 2-week robotic curriculum. A survey was administered to evaluate long-term training effects. Attending robotic surgeons were surveyed regarding teaching practices and resident expectations. Surveys utilized 5-point Likert scales.

RESULTS: Surveys were distributed to 23 residents and 16 attendings with 83% (19) and 69% (11) completion, respectively. Spearman correlation coefficient between skill change and case volume was r = 0.52 (p = .02). Lack of robotic volume was the most common explanation for perceived skill degradation. Overall robotic confidence declined with 13 residents feeling "slightly/very confident" at the time of survey completion versus 18 residents feeling as such immediately following the curriculum. Both residents and attendings rated "knowledge of the operation's steps," "safety of movements," and "tissue handling" as "very influential" on whether residents should operate independently. All 11 attendings expected graduating residents to be able to independently perform certain robotic skills and typically grant greater independence for basics like port placement - especially during simpler operations like cholecystectomies versus pancreaticoduodenectomies. However, in only 1 out of 60 surveyed tasks across multiple robotic operations would every attending allow complete resident independence versus hands-on assistance.

CONCLUSION: While a formal robotic curriculum provides necessary confidence and skills, the lasting impact may be diminished by subsequent limited robotic exposure and autonomy. Deliberate integration as console surgeon, with intentional scheduling of high-volume robotic rotations shortly following the curriculum, as well as skill maintenance outside of the operating room are all essential for residency robotic training success.

Poster #9

Implementation of a Surgical Robotics Curriculum for Surgery Clerkship Medical Students

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INTRODUCTION: While robotic surgery has grown exponentially over the last decade, medical students receive little robotic training, presenting a discrepancy between medical education and modern care. It has been demonstrated that a medical student robotics training curriculum is feasible, acceptable, and increases self-reported preparedness. We propose a longitudinal robotic training curriculum for medical students that will determine feasibility, while also tracking and assessing knowledge and competency.

METHODS: During their surgical clerkship, second year medical students can sign up for the curriculum, which is split into two pathways: bedside and operating skills. First, students will complete an augmented reality training equivalent to the in service on the da Vinci Xi robot. After completion of the bedside component, students will receive access to online modules through an Intuitive SimNow account. Throughout the year, students can participate in the existing, department-wide "Module of the Month" competition. In the third year, after successful completion of the online modules, students can participate in a proctored training of robotic bedside and operative skills on the Xi platform. Fourth year students who have completed all modules will participate in a final assessment on their robotic knowledge and skills. Passing students will receive access to the full MyIntuitive account and mobile application, as well as a certificate of completion.

RESULTS: Preliminary data will be collected every six months on student satisfaction and performance on robotic skills. For simulation skills, student performance will be tracked and recorded through the MyIntuitive app. At the completion of the curriculum, students will complete an in-person evaluation using a robotic skills checklist to assess their competency in both bedside and simulated operating skills.

CONCLUSION: We believe this longitudinal curriculum will be feasible and effective in stimulating interest, while also increasing medical student readiness and competency in surgical robotic skills.

Poster #10

An Open Surgical Skills Training Program for the Teaching of Urology Trainees

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INTRODUCTION: While minimally invasive surgery (most commonly the surgical robot) has replaced the majority of open surgical procedures within urology, open surgery remains a critical tool in the urologist's armamentarium. Additionally, though urologists' surgical focus is primarily the genitourinary and reproductive systems, urologic surgery also necessitates comfort and proficiency within other surgical domains, particularly intestinal and vascular surgery. There is a critical deficit in open surgical experience that exists for urology residents and fellows. Here, we present a simulation program for open surgical skills for urology trainees.

METHODS: Didactic, pre-clinical surgical skills models, and wet lab trainings were developed. Participant surveys and evaluations were created to assess pre- and post-session competence. Pilot data collection is ongoing.

RESULTS: Open surgical skills training was conducted over two days. Didactic sessions were followed immediately by pre-clinical surgical skills models, then followed by open swine wet lab training, thereby reinforcing theory and concepts into practical skills. Didactic sessions included bowel anastomoses with colorectal surgeons and management of vascular injuries with vascular surgeons. Open surgical skills models included open hand knot tying, vessel ligation and repair with bovine arteries and Gore-Tex vascular grafts, animal model intestinal anastomoses, and wound closure. Swine wet lab sessions focused on vascular control and repair (aorta, inferior vena cava, and renal and pelvic vessels), and open urologic procedures (partial and radical nephrectomy, retroperitoneal lymph node dissection, pelvic lymph node dissection, ureteral repair, and ureteroenteric anastomoses).

CONCLUSION: A comprehensive open surgical skills training program was successfully implemented for urology trainees. Pilot data collection will be utilized to quantify impact on trainee competence and to update the program for future sessions.

Poster #11

Optimizing Pediatric Trauma Resuscitation: Addressing Gaps in Team Dynamics through Targeted Simulation Training

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INTRODUCTION: Trauma is the leading cause of childhood mortality in the United States, underscoring the necessity of an efficient pediatric trauma resuscitation (PTR) team. The pressure of treating critically injured children often leads to unclear roles, communication lapses, and a lack of adherence to standardized protocols, hindering team effectiveness. We previously developed a multidisciplinary adult trauma simulation curriculum focused on improving adult trauma resuscitations. Guided by this, we performed a needs assessment to evaluate the gaps in PTR practices, identify areas for improvement, and develop a similar comprehensive interdisciplinary PTR curriculum to address these gaps.

METHODS: An anonymous interdisciplinary survey was administered to individuals involved in PTRs, gathering detailed information on respondents' specialties, PTR experience, role comprehension, and insights into communication, role clarity, and trauma survey thoroughness.

RESULTS: There were 45 survey respondents: 11 (24%) emergency medicine senior residents, 9 (20%) pediatric surgery junior residents, 8 (18%) pediatric surgery senior residents, 8 (18%) attending physicians, and 5 (11%) nurses, among others. Most respondents (n=21, 47%) had limited experience (≤5 resuscitations) with Level 1 PTRs, while the majority (n=25, 56%) had participated in >15 Level 2 PTRs. 42 (93%) were very/extremely familiar with trauma team roles; however, only 25 (56%) reported that these roles are clearly defined during PTRs, and only 29 (65%) noted that a trauma team leader is regularly identified. Additionally, 35 (78%) felt communication in the trauma bay is unclear, with 39 (87%) identifying non-essential personnel as a contributing factor.

CONCLUSION: We plan to initiate a pilot study involving multidisciplinary PTR simulations to address the shortcomings identified in the survey by developing a curriculum to guide these simulations, focusing on trauma survey processes, adherence to roles, patient stabilization, and team communication. These simulations aim to refine our approach to pediatric trauma care and improve resuscitation outcomes.

Poster #12

Skill of the Week: Implementing and Monitoring a Microskills Curriculum for General Surgery Residents

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INTRODUCTION: We previously identified significant barriers for surgical residents to independently practice technical skills, including time constraints and lack of equipment. To expand technical skills practice, we developed a "Skill-of-the-Week" (SOW) curriculum focused on discrete MicroSkills to create a foundation for procedural skills.

METHODS: Every other week, residents were emailed a four-slide PowerPoint presentation describing a MicroSkill, including an embedded video of faculty demonstrating the skill. The materials to complete the MicroSkill were distributed to resident workrooms at varying clinical sites. Viewership trends were measured through a private YouTube® account. A feedback survey was completed six months after SOW initiation. Technical ability to perform the MicroSkills was assessed during a formalized simulation assessment day.

RESULTS: SOW has continued since October 2024 with minimal interruptions and frequent supplies replacement. Junior-level videos were watched more frequently than senior-level videos. There were ten responses (18% response rate) to the midpoint feedback survey (8 juniors and 2 seniors). Residents reported that the top three barriers to independent skills practice are a lack of time and materials and a lack of structured teaching, which is unchanged from the pre-implementation survey. Half of the respondents reported watching the videos but not practicing the skills. Forty percent reported they "probably" have improved their surgical performance since engaging in SOW, with one reporting they "pay more attention to the MicroSkills required during an operation." We saw an increase in viewership before the resident simulation assessment day.

CONCLUSION: Residents who have engaged with the SOW curriculum are reporting improvement in their skill levels. The developed resources are being used by residents across multiple training sites, improving access to virtual content while building a repository. Strategies to improve program engagement are being implemented, such as interval competency evaluation, increased advertisement of the video repository, and increased faculty engagement.

Poster #13

From Words to Action: Problem Identification and Needs Assessment for an Interdisciplinary Pediatric Trauma Resuscitation Curriculum

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INTRODUCTION: Trauma is the leading cause of death in children in the United States. It is imperative to have organized and efficient trauma resuscitations to care for the critically injured child. Barriers to an effective team are lack of role-recognition, poor communication, and lack of standardized protocols. Recognizing gaps at our institution, we performed a needs assessment to evaluate pediatric trauma resuscitations to facilitate identification of areas of improvement to develop an interdisciplinary pediatric trauma curriculum.

METHODS: An anonymous interdisciplinary survey was sent to those who participate in pediatric trauma resuscitations at our level 2 pediatric trauma center. Inductive codes were created based on common themes within the free-text responses. These codes included role-recognition, communication/volume, over-crowding, and organization.

RESULTS: Forty-five participants took the survey including emergency medicine, pediatric surgery, pediatric critical care, and nursing staff. Four main themes were identified: Role-recognition, Communication/Volume, Over-Crowding, and Organization. Role-recognition included comments regarding lack of clarity of trauma team leader (lack of defined roles or multiple members over-taking the role simultaneously). Communication/Volume included comments on competing voices and prohibitive noise level. Over-crowding included comments on too many non-participants creating clutter and confusion during the trauma survey. Organization included comments regarding performance of the primary and secondary survey and trauma resuscitation tasks.

CONCLUSION: Preliminary data demonstrate clear gaps in training with pediatric trauma resuscitations and the importance of interdisciplinary simulation-based training. As we continue to gather more data, a latent content analysis will be performed to further analyze textual data. A pediatric trauma simulation curriculum is being developed alongside remodeling of the trauma bay for clear role identification. Following successful implementation of pediatric trauma simulations, we will progress to in-situ simulations with the expectation of significantly improving pediatric trauma resuscitation flow.

Poster #14

Comparative Effectiveness of Two Mastery-Based VR Robotic Training Curricula in Surgical Education

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INTRODUCTION: Robotic surgery requires specialized training programs to ensure proficiency. Virtual Reality (VR) simulators offer a safe option for skill acquisition. Previous studies have demonstrated the feasibility of a mastery-based VR curriculum. This study aims to provide robust evidence supporting the integration of our VR-based training curricula, refined from 33 to 19 SimNow drills, for robotic surgical training. By optimizing the number of drills, we aim to enhance training efficiency while upholding high standards of competency.

METHODS: Performance of 82 surgery residents was retrospectively analyzed. The initial cohort of 41 residents completed the previous curriculum with 33 SimNow drills, while a subsequent cohort of 41 residents completed the refined curriculum with 19 drills. Pretest and posttest scores, along with completion times were computed for both cohorts. Paired t-tests and Mann-Whitney U tests were used to compare the performances of both cohorts.

RESULTS: In the previous cohort, the median test score increased from 62 (IQR: 126-28) to 353 (IQR: 366-317), with a median score improvement of 273 (IQR: 315-201) ($p < 0.001$), and a median time reduction of 840 seconds (IQR: 1169-565) ($p < 0.001$). In the refined cohort, the median test score increased from 70 (IQR: 139-37) to 349 (IQR: 372-290), with a median improvement of 245 (IQR: 286-194) ($p < 0.001$)), and median time reduction of 950 seconds (IQR: 1427-561) ($p < 0.001$). No significant differences were found between the post-test scores ($p = 0.759$) or times ($p = 0.279$) between the curricula. Additionally, no significant differences were found in either score improvement ($p = 0.269$) nor time reduction ($p = 0.427$) between the cohorts, demonstrating comparable efficacy.

CONCLUSION: The refined VR SimNow curriculum demonstrated skill improvements and time efficiency comparable to the previous cohort's performance, supporting its feasibility and effectiveness as a tool for robotic surgical training.

Meet the Authors Poster Session

Learner Assessments and Program Evaluations, Posters 15–24

Poster #15

Enhancing Timely Diagnosis and Surgical Intervention of Pediatric Congenital Anomalies in East Africa through a Surgical Simulation Educational Model

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INTRODUCTION: The scope of surgical simulation training can be extended to include caregivers of newborns in low- and middle-income countries (LMICs), to enhance timely detection of congenital surgical anomalies. We are using surgical simulation models to teach mothers in East African maternity hospitals how to recognize signs of congenital anomalies in their newborns. Existing programs primarily train healthcare workers to detect visible external anomalies. While important, these programs do not address internal congenital anomalies such as esophageal atresia and diaphragmatic hernia, which often have higher mortality rates due to delayed surgical intervention and complications.

METHODS: We have integrated surgical simulation-based education focused on signs corresponding with congenital anomalies (e.g., cyanosis, stridor, chest retractions, bilious vomiting, feeding difficulties) into routine post-natal counseling sessions. Recognizing that many mothers are discharged within a few hours post-delivery in government hospital settings, we emphasize comprehensive education using videos, visuals, and interactive tools. This approach aims to reduce visits to pediatric surgical wards prompted by children with advanced, undetected surgical conditions. Program effectiveness will be assessed through the evaluation of timely surgical interventions enabled by maternal recognition of congenital anomalies.

RESULTS: The program is currently being piloted at two hospitals, in Kenya and Tanzania. Feedback from healthcare providers and participating mothers is being collected to refine the educational resources and delivery methods. Initial observations suggest that integrating education into routine post-natal practices is feasible and well-received by both staff and mothers. We will disseminate our final results.

CONCLUSION: Our scalable teaching model can be implemented in similar settings globally, contributing to significant reductions in neonatal and under-5 mortality rates. The benefits of surgical simulation extend beyond traditional clinical environments. Our project highlights the importance of a multidisciplinary strategy in tackling global surgery challenges and shows how surgical simulation training can improve healthcare outcomes on a larger scale.

Poster #16

Training Staff and Patients as Simulation Professionals Improves Access to High-Quality Professionalism Training

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INTRODUCTION: Decades of research have demonstrated that provider communication behaviors with patients and peers impact patient outcomes. Research suggests that educational reform is needed in 1) curriculum development, 2) faculty and practitioner development, 3) partnering with patients, and 4) education research. Our health system has a well-established communication program that uses staff and patients in simulation during professionalism training of physicians, residents, medical students and nursing staff. We aimed to identify best practices when training trainers for communication workshops to perform as actors, facilitators, and simulation debriefers.

METHODS: This quasi-experimental research study assessed behavior and confidence changes in a cohort of hospital staff, former patients, and surgeon educators before and after participating in a half-day workshop focused on skills needed to engage in high quality simulation training of providers. Pre/post surveys captured previous training, attitudes, and confidence performing target skills such as portraying a patient in simulation, providing actionable feedback, and facilitating a simulation debriefing. Observers rated learners on simulation performances.

RESULTS: Hospital staff (n=15), physicians (n=4) and former patients (n=4) attended the training. Confidence scores increased in target skills: offering actionable feedback regarding communication (p=0.029), offering feedback regarding non-verbal behavior (p=0.014), facilitating a debriefing (p=0.019). Confidence scores were validated using observer assessments in simulation; each point increase on the five-point confidence scale for "portraying a patient" and "offering helpful feedback" was associated with an increased likelihood of being rated "excellent" in simulation [OR 2.01 ($p<0.005$) and OR 1.53 ($p<0.001$) respectively]. Annual train-the-trainer workshops have resulted in a volunteer team of 30 trained simulation professionals available to staff regularly scheduled training modules.

CONCLUSION: A simulation-based faculty development workshop improves trainer confidence and skill engaging in communication training for providers; having a large team of trained actors and facilitators within the hospital system increases access to important skills-based communication training.

Poster #17

Residents Perceptions of Surgical Simulation in Senegal: Results of a Nationwide Survey

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INTRODUCTION: Traditionally, the teaching of surgical disciplines has relied on hands-on learning in the operating room under the supervision of experienced surgeons. However, increasing constraints in terms of time and resources, along with a heightened focus on patient safety, have led to the adoption of alternative educational methods such as simulation. This study aims to evaluate the current state of simulation use in the teaching of surgical disciplines in Senegal.

METHODS: This national cross-sectional study followed CHERRIES guidelines and was conducted from June 2 to June 15, 2024. All surgical trainees from universities across Senegal were included. The parameters studied were age, gender, surgical specialty, year of study, and previous simulation experience. Satisfaction with simulation training was assessed using a 5-point Likert scale.

RESULTS: There were 234 participants with the following specialty distribution: general surgery (18.8%), obstetrics and gynecology (16.7%), otorhinolaryngology (13.2%), urology (12.8%), oncological surgery (5.1%), pediatric surgery (6.8%), plastic and reconstructive surgery (2.6%), thoracic and cardiovascular surgery (5.1%), neurosurgery (4.7%), ophthalmology (4.3%), and orthopedics and traumatology (9.8%). There were 23.9% women and 76.1% men, with an average age of 31.0 ± 3.7 years. Overall, 69.2% of participants had never participated in simulation training. Among those who had, the simulation models used were inanimate models (6.4%), virtual reality simulators (3.8%), and explanted tissues (3.8%). 87.2% had a favorable opinion, as did 88.8% regarding the confidence gained through simulator training. Additionally, 71.4% agreed on the necessity of mastering surgical techniques through simulation before practicing in the operating room.

CONCLUSION: The survey reveals that surgical trainees in Senegal recognize the potential benefits of simulation in their training, despite the majority not yet having had the opportunity to participate in simulation sessions. It is essential to promote and facilitate simulation-based training to enhance the quality of their education and ensure patient safety.

Poster #18

Global Impact of Two American College of Surgeons Simulation Fellowships

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INTRODUCTION: The role of simulation-based education for training has expanded over the last two decades. "Healthcare Simulation Science" has begun to emerge as a multidisciplinary endeavor including an understanding of our clinical discipline and its greater role in the healthcare system, education, engineering, and the arts. The inherently diverse nature of this new field has been stymied through a lack of a unified and shared understanding of knowledge, skills, nomenclature, and culture of the disparate fields involved. To facilitate growth, there was a need to develop a formal training program to prepare individuals to lead and develop programs to more effectively disseminate the benefits of simulation worldwide.

METHODS: The first formal surgical simulation training fellowship was created in 2009 at the University of Minnesota. A formal structured curriculum with leadership, administrative, research and education learning objectives were presented to the American College of Surgeons to establish an accreditation process, and it was approved in 2012. As of 2023, 20 programs are now accredited by the ACS to provide this type of education around the world. Impact metrics from fellows at two institutions were measured through follow-up structured interviews with the former fellows.

RESULTS: At the two institutions, between 2009-2023, including a pandemic that significantly impacted training opportunities, twelve fellows have graduated from the program. To date, amongst many other impactful, broader healthcare initiatives, the fellows collectively have provided 84,278 l-h, developed 35 simulators, contributed to the creation of 170 curricula, published 53 simulation articles, are leading 4 international simulation centers, lead/found 5 international training programs and started 3 simulation companies.

CONCLUSION: Formal simulation science training of surgeons has the potential to make an enormous impact on the development, deployment, and global dissemination of skills through simulation-based education.

Poster #19

Impact of Simulation Hours on Performance of Robotic Lobectomy on Ex Vivo Perfused Porcine Model

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INTRODUCTION: How experience with robotic simulation training translates to practical surgical skills remains unclear. We aimed to explore if self-reported simulation time correlates with performance on a robotic lobectomy (RL) in a perfused ex vivo model.

METHODS: Fellows from Society of Thoracic Surgeons Resident Boot Camp completed RL on an ex vivo perfused porcine model, while a novel data recorder captured synchronized video and kinematic data to calculate objective performance indicators (OPIs). This study focused on the superior pulmonary vein (SPV) dissection. To measure competency in SPV dissection, we used a previously developed assessment tool that had evidence of validity. The tool contains 12 items organized into four levels of increasing difficulty: completion (0-3), safety (4-6), efficiency (7-9) and mastery (10-12). Completion and safety each consist of three video-based review items assessing task completion, bleeding, and tissue handling. Efficiency and mastery each consist of three OPI items (i.e. completion, bleeding, tissue handling, wrist articulation, instrument movement, energy, smoothness, clutching, and instrument time). Fellows completed a demographic form. We calculated a Pearson's correlation coefficient between the assessment scores and self-reported hours of simulation training.

RESULTS: Twenty-nine fellows participated, including 12 women and 17 men from 21 traditional and 8 integrated cardiothoracic programs. Self-reported simulation hours ranged from 0-70 hours (Mean=13.79, SD=14.76). Participants obtained an average total score of 7.79 (SD= 3.42) on the assessment tool. Eight (28%) fellows scored below efficiency. The correlation between simulation hours and RL performance was -0.145 ($p = .45$), and similarly, no significant correlation was observed with only video-based items, OPI items, or scores at each level.

CONCLUSION: Self-reported simulation hours did not correlate with performance on RL on an advanced tissue model. While simulation hours may not have been accurately reported, these findings merit exploring how best to optimize robotic simulation practices.

Poster #20

Towards Automated Assessment: Can an AI Model Accurately Predict Task Completion Time? A Case Study in Advanced Training in Laparoscopic Suturing (ATLAS) Simulator

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INTRODUCTION: The Advanced Training in Laparoscopic Suturing (ATLAS) curriculum is a proficiency-based program designed to improve laparoscopic skills through a series of six tasks. Task 1 requires driving a needle through 6 holes oriented at different angles on a circular platform. Performance measures include task completion time and errors evaluated through in-person and video review. This study aims to investigate the potential of an artificial intelligence (AI) model to accurately predict Task 1 duration.

METHODS: A total of 49 videos of Task 1 performances from medical students, trainees, and faculty at two institutions were recorded for analysis. Trained raters assessed task duration and errors within each video. Each video was annotated to mark the beginning and end frames of ten distinct phases of the task. The X3D deep convolutional neural network model was employed to train automated detection of the 10 phases. Additionally, a hybrid approach combining a smooth averaging filter (SMA) and ATLAS K-Nearest Neighbors (KNN) was used to segment phases in a sequential manner to compute the task duration from the model predictions in post-processing.

RESULTS: A total of 39 videos were used for training and 10 for testing the model. For phase segmentation, the original model achieved an accuracy of 82.06% which was further improved to 89.68% using the hybrid of SMA and AKNN. Using the best result from phase segmentation for computing time duration, our approach yielded an average measurement error of approximately 0.84% [0-2.33 %] compared to the ground truth.

CONCLUSION: The AI model predicted task duration time of the ATLAS Needle Handling task with high accuracy and could be implemented as a tool for proficiency evaluation, decreasing the resources required for assessment. Future directions include improving accuracy of this model and extending model development for assessment of the additional five ATLAS tasks.

Poster #21

Enhancing the Pedagogical Approach to Implantable Central Venous Catheter Placement Utilizing Tissue Models among First-Year General Surgery Residents

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INTRODUCTION: The increasing use of implantable central venous catheters (ICVCs) for chemotherapy has necessitated that general surgery residents develop proficiency in their insertion. Given the critical importance of technical expertise and patient safety, simulation-based training has emerged as an effective method to enhance resident confidence and competence. This study aims to evaluate the effectiveness of a structured ICVC training program utilizing tissue models among first-year general surgery residents.

METHODS: We implemented a structured teaching-learning process using simulation methodology, designed to develop both technical and non-technical skills in ICVC insertion through three progressive phases. **Phase 1** involved conceptualization, focusing on the theoretical understanding and clarification of the procedure. **Phase 2** utilized part-task simulation, allowing residents to practice specific aspects of the procedure, such as ultrasound-guided vascular access and surgical techniques for ICVC placement. **Phase 3** integrated these skills in a hybrid simulation, emphasizing knowledge application, decision-making, and complication management.

RESULTS: The pre-simulation conceptualization phase significantly enhanced residents' understanding of the procedure, particularly regarding the necessary supplies, the ultrasound-guided vascular access technique, and the surgical steps for ICVC placement. The tissue model simulations facilitated familiarity with anatomical landmarks, refined insertion techniques, and emphasized the creation of subcutaneous pockets. In the hybrid simulation phase, residents demonstrated improved procedural skills, enhanced decision-making capabilities, and a better ability to prioritize problem-solving strategies, as evidenced by pre- and post-simulation checklists.

CONCLUSION: Simulation-based training for ICVC insertion effectively bridges the gap between theoretical knowledge and clinical practice. This approach fosters the acquisition of both technical and non-technical skills, instilling confidence in residents and reducing the likelihood of complications in real-world scenarios.

Poster #22

Learning Laparoscopic Skills: Shaping Surgical Careers with Targeted Simulation Training

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INTRODUCTION: Basic surgical skills are a requirement to graduate medical school in the United Kingdom; however, exposure to training immediately after graduation can be difficult. Foundation doctors are often inundated with tasks, preventing time in the operating room when rotating through surgical specialties. The aim of this project was to provide laparoscopic training to foundation doctors, regardless of career choice, via surgical simulation and education.

METHODS: Participants were recruited via a "Surgical Skills Competition", utilizing Personal Development Planning (PDP) time for training on the virtual laparoscopic kit provided - Laparos by VirtaMed. Only non-surgical trainees (first- and second-year doctors) were actively recruited. Participants were provided a 10–15-minute tutorial on how to operate the simulator. Doctor hours and performance were recorded and analyzed utilizing the VirtaMed data collection and analyze system.

RESULTS: Total of 20 participants were included in the study. Qualitative data showed 90% had experience in general surgery with 80% having up to 10 operational cases. All participants would utilize the surgical simulator, time permitting, and felt it provided them basic understanding of the difficulty behind surgical procedures. Participants felt encouraged to explore a career in surgery (90%) and that it improved their hand-eye coordination (100%), as well as instrument handling skills (90%). It provided participants more confidence in performing procedures (90%). Quantitative data demonstrated significant increase in performance in majority of participants (e.g. time, spatial awareness, instrument distance, camera manipulation).

CONCLUSION: Surgical experience has become increasingly hard for junior doctors, given the demand of the job. Surgical simulation can provide foundation doctors with key, basic skills in a safe environment. This method combines a mix of pedagogy and andragogy learning methods that address current and ongoing issues within surgical training; as well as addressing hidden curriculums within the surgical field - influencing careers, mentorship, and early development.

Poster #23

Effectiveness of Advanced Training with Experience Exchange between Bulgarian and American Specialists in Laparoscopic Surgery in Gynecology, General Surgery, and Urology

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INTRODUCTION: Introduction. Globally, laparoscopic surgery is a preferred method for surgical interventions due to numerous specific advantages beneficial to all parties involved. Objective. Our objective is to assess the effectiveness of enhancing knowledge and techniques in laparoscopic surgery through experience exchange between leading laparoscopic specialists.

METHODS: Materials and Methods. From April 23 to 26, 2024, laparoscopic surgeons from the Medical University of Pleven, in collaboration with specialists from SLS USA, conducted an intensive four-day laparoscopic surgery course with 24 participants from across the country. The effectiveness of the training was evaluated after its completion, with 19 out of 24 participants completing a Google Forms survey.

RESULTS: Results. Among the participating specialists and young doctors, 44.4% were men and 55.6% were women. Of these, 16.7% were residents, 55.6% were doctors with a specialty, and 27.8% were specialists with experience in laparoscopic surgery. 83.3% rated the course with the highest score. The most effective aspect of their participation (50%) was working with live tissue, followed by robotic surgery (11.1%), laparoscopic suturing exercises (27.8%), and the lecture component (11.1%).

CONCLUSION: Conclusion. Continuous advanced training for both residents and doctors with established specialties improves skills in theory and practice. The interdisciplinary model involving doctors who participated in the course enhances collaboration between different units and increases the effectiveness of patient treatment. Keywords: laparoscopic surgery, training, interdisciplinary training

Poster #24

Sharpening Skills Beyond the OR: How Continuous Simulation Enhances Laparoscopic Surgery for Practicing Surgeons in Limited-Resource Settings. A Prospective Observational Study on the Impact of a 40-Hour Simulation-Based Laparoscopic Training Program

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INTRODUCTION: Laparoscopic surgery is a core skill for modern surgeons, but even certified professionals may experience skill decline without ongoing training. This raises a critical question: Is continuous simulation necessary to maintain high standards of care? Simulation offers a risk-free platform for refining techniques and preventing skill degradation. This study evaluates the impact of a 40-hour simulation-based training program aimed at enhancing laparoscopic skills among active surgeons in Ecuador.

METHODS: A cohort of practicing surgeons from various healthcare facilities participated in a structured 40-hour laparoscopic simulation training program in Quito, Ecuador. Certified surgeons led the training, offering expert guidance and real-time feedback. Performance was evaluated using standardized rubrics focused on both technical precision and procedural efficiency. Pre- and post-training assessments measured completion times and error rates across 11 laparoscopic exercises. Data was analyzed using a two-sample t-test via IBM SPSS to determine statistical significance.

RESULTS: The training program demonstrated significant improvements in laparoscopic performance. Post-training, completion times showed a statistically significant reduction ($p<0.05$) across all 11 exercises, indicating increased procedural efficiency. Error rates also decreased significantly ($p<0.05$) in all exercises, reflecting enhanced technical precision and overall skill proficiency. These consistent gains suggest that ongoing simulation training can effectively sharpen and sustain surgical skills, even for those already practicing.

CONCLUSION: This study highlights the critical role of simulation in maintaining and advancing laparoscopic skills among active surgeons. As surgical practice evolves, continuous simulation-based education offers a sustainable model to ensure consistent high-quality care. Our findings underscore the need for scalable and accessible simulation programs, potentially delivered remotely to support ongoing professional development. Establishing dedicated laparoscopic simulation centers in limited-resource regions like Ecuador could dramatically improve surgical capacity and patient outcomes, serving as a blueprint for global health initiatives.

Meet the Authors Poster Session

Simulator and Medical Device Development, Posters 25–41, 44

Poster #25

A Patient-Specific Phantom for Training in Traditional and Augmented Reality Neuronavigation

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INTRODUCTION: The use of neuronavigators for brain tumor management has increased in recent years, and a growing interest in developing Augmented Reality (AR) solutions has been reported in the literature. However, effective use of these technologies requires innovative training solutions and evaluation methods.

METHODS: To address this, we have designed a procedure for creating patient-specific head phantoms for training in AR surgical navigation. The simulator allows practice in 1) surgical planning of the optimal access path and craniotomy, 2) setup of AR surgical navigation including image-to-patient registration, and 3) performing skin incision and navigated craniotomy with real instruments. The head phantom is created from a real MRI dataset and fabricated using 3D printing. It consists of a reusable base and a changeable skull part for single use. The phantom features a replica of the skin and a changeable brain model with a planned lesion can be inserted inside the skull. The phantom also features multiple 1 mm diameter holes for evaluating navigation accuracy. Custom-made bone flaps designed in different sizes (decreasing in steps of 0.5 mm from the size of the ideal trajectory) allow the assessment of craniotomy precision.

RESULTS: The simulator is currently being used to train in using the VOSTARS system, an AR head-mounted display developed within the Horizon 2020 project framework. The system displays planned craniotomy trajectories over the manikin skull, and the navigation accuracy and user precision in performing the craniotomy are quantitatively evaluated at the end of the simulation. Promising results have been obtained with a single neurosurgeon.

CONCLUSION: Face and content validity tests are scheduled. The phantom represents a promising approach for training in traditional and AR neuronavigation.

Poster #26

Enhancing Incision and Drainage (I&D) Skills through a Low-Cost, Realistic Training Model

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INTRODUCTION: Incision and drainage (I&D) is the primary treatment for most cutaneous abscesses, a common clinical issue. However, many novice residents and physicians who do not routinely perform I&Ds often feel unprepared, leading to delays in patient care. To address this concern, we sought to develop an I&D training model to boost physicians' confidence and knowledge, thereby encouraging timely I&Ds in clinical practice.

METHODS: The training model was created using commercially available products including a latex balloon filled with a yogurt-oatmeal mixture to simulate fluid collection, low-loft batting, felt, cloth, and optional milled pigskin. Participants, including novice surgical residents, primary care physicians, and medical students, used a 15-blade scalpel, tissue forceps, scissors, and packing strip to perform I&Ds in a surgical skills lab. A retrospective pre-post survey was administered anonymously to assess participants' experiences.

RESULTS: Each model was produced in 6 minutes at a cost of $2.29, offering significant cost savings compared to commercially available options. All participants rated the model as somewhat or very realistic. Post-training, 100% of participants felt somewhat or very confident in their abilities to perform an I&D, compared to 31% pre-training ($p = 0.001$), and 93% reported being somewhat or very likely to perform an I&D in practice, compared to 46% pre-training ($p = 0.030$). All those who had the opportunity to perform an I&D in the field post-training did so, reporting that the training had been beneficial. The majority (62%) recommended annual training to retain the skillset.

CONCLUSION: We developed a cost-effective, realistic model for I&D training that can be easily reproduced. This model effectively teaches an important skillset to a diverse group of healthcare providers, empowering them to confidently perform I&Ds in clinical settings to help treat patients.

Poster #27

Precision in Sight: Improving Visual Clarity in Laparoscopic Surgery for Surgical Trainees

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INTRODUCTION: Laparoscopic surgery presents the unique challenge of balancing visibility with efficiency. Only 56% of operating time is spent with a clear visual field. Obstructions occur an estimated 3 - 10 times on average for each laparoscopic case and require between 20 to 60 seconds to clean. For trainees this can potentially disrupt the flow of practice and extend the overall training duration. It is necessary for a new device that addresses these laparoscopic challenges and provides an improved, robust experience for surgical trainees and surgeons alike.

METHODS: Our device consists of a lens cap which mounts to the front of a laparoscopic camera. The cap comprises a piezoelectric transducer, a transducer control system, and a piezoelectric driver. The piezoelectric transducers emit high-frequency ultrasonic waves to autonomously clean the camera lens intra-abdominally, effectively removing debris thereby ensuring high-resolution imaging throughout the laparoscopic procedure. The introduction of this device in training modules allows for continuous practice without such interruptions, enabling trainees to focus on refining their techniques.

RESULTS: Our preliminary results feature a large-scale functional prototype, and stakeholder feedback to refine our device, its functionality and potential interest in its implementation in laparoscopic surgery.

CONCLUSION: The following steps in our project include finalizing our prototype with scaled electronics and further iterations of the prototype to extend battery life and optimize ultrasonic frequency. We also propose a study to determine the effectiveness of our device by measuring the duration of surgery in trainees with and without the device. Further stakeholder analysis will also be conducted to validate the design elements, implementation, and user satisfaction.

Poster #28

Mindfulness Training for Surgical Skills Simulation

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INTRODUCTION: Mindfulness, the practice of non-judgmental present-moment awareness, enhances performance in high-stress environments. For surgery residents, mindfulness-based interventions may improve attention and surgical performance. The integration of mindfulness into surgical simulation training remains underexplored, with no studies using mindfulness practices while simulating surgical skills. We aim to assess the feasibility of implementing mindfulness training while performing a surgical skill into the intern curriculum.

METHODS: Surgical interns (general, otolaryngology, vascular, plastics) were recruited by opt-in during orientation in June 2024. Participants were invited to use a mindfulness app at their own pace. During surgical skills testing in July, participants "warmed up" by listening to guided meditations that focused on present-moment mindfulness while practicing with simulation materials. Non-participants used warm-up time freely. Data on prior meditation experience, app usage, and feedback on the meditations were collected. Feedback was analyzed through qualitative content analysis.

RESULTS: Of 21 interns, 20 (95%) opted-in to mindfulness training. Twelve (57%) were female, and 13 (65%) had prior mindfulness experience. Thirteen (65%) used the mindfulness app, with nearly half (46%) using it weekly or more. Fourteen participants provided feedback on the guided meditations. The most frequently reported theme expressed by 10 (71%) was the calming or grounding effect, particularly when feeling nervous. Four (29%) reported benefits of focusing and paying attention to performing the surgical skills. Challenges included mind-wandering or distracting thoughts, often associated with thinking about work-related tasks, reported by 5 (36%).

CONCLUSION: The integration of guided meditations into the surgical simulation curriculum was well-received, with interns reporting benefits like calmness, grounding, and improved focus. Challenges with mind-wandering were expected. These preliminary findings show that incorporating mindfulness in surgical simulation training is feasible, had high levels of participation, and was well-received. Future research will explore the long-term impact on skill acquisition and performance.

Poster #29

Immersive Cardiac Mastery: Exploring Congenital Heart Anomalies through 3D Printing and Augmented Reality

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INTRODUCTION: Partial Anomalous Pulmonary Venous Return (PAPVR) is a rare congenital heart defect in which one or more pulmonary veins connect abnormally to the right atrium instead of the left. Due to its complex and variable anatomy, diagnosis and surgical correction are challenging. We aim to evaluate the effectiveness of 3D and augmented reality (AR) models in enhancing the understanding, planning, and simulation of congenital heart disease surgeries.

METHODS: An adult CHD surgeon selected three PAPVR cases, and the CTA images were imported into Mimics Medical software for digital segmentation. Hollow heart models were created by subtracting blood volume from extracardiac anatomy. The models were then optimized via retopology in ZBrush and converted to Universal Scene Description (.USDZ) format for use in a custom Apple Vision Pro app built with RealityKit. The textured models were also exported in STL format for 3D printing at a 1:1 scale on a Stratasys J750 in full color and flexible photopolymer resin to enhance realism for surgical simulation. Special attention was given to model wall thicknesses to allow for effective suturing during training of ACHD-related defect repairs.

RESULTS: Thirty-seven healthcare workers attended the pilot course, with 22 pre-registered. Seventeen participants responded to an 8-question survey, and most found 3D-printed models more valuable than AR. Over 70% felt AR and 3D-printed models offered significant advantages over traditional imaging for visualizing and understanding CHD lesions.

CONCLUSION: Incorporating 3D-printed models and AR simulations into cardiac surgery training is a transformative method for educating healthcare workers in managing PAPVR. These tools significantly enhance the learning experience, improve surgical planning and execution, and ultimately contribute to better patient outcomes.

Poster #30

Implementation of Plant-Based Biodegradable 3D-printed Trocars in Medical Training

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INTRODUCTION: Recent advances in 3D printing technology have made it possible to print surgical devices, however the literature on this field remains limited. The benefits of 3D printed instruments include cost reduction and patient customization, however their usage in clinical practice still remains constrained due to lack of reliability and sufficient data. In our study we created 3D printed PLA endoscopic trocars in order to investigate if such instruments are functional and what are the benefits and the limitations.

METHODS: We used Dassault Systems SolidWorks in order to design 5 and 10mm endoscopic cannulas, obturators and one-way valves, using plant-based biodegradable PLA and printed via an EOS EOSINT P 390 and a SOVOL SV01 PRO 3D printers. Six 5mm trocars and three 10mm trocars were created after the parts were assembled. Three porcine cadavers were used and one decommissioned laparoscopic insufflator in order to establish pneumoperitoneum. The CO2 leakage was measured through insufflation device monitoring during establishment of pneumoperitoneum and during instrument implementation.

RESULTS: The cost of producing the parts amounted to 0.52 USD/trocar, with no functional difference and price between the two printers. Three trocars were used per cadaver. Pneumoperitoneum was established successfully in every case and no leakage was identified while using the instruments, except for one case where a leak was identified and the 10mm trocar was replaced eliminating the leak. One trocar failed during the task.

CONCLUSION: The implementation of 3D printed PLA trocars can be utilized for simulation surgery and educational purposes due to their affordability and environmental sustainability. However further testing and development is necessary in order to improve quality and reliability.

Poster #31

Plant-based Biodegradable 3D-printed Surgical Instruments: Enhancing Medical Education

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INTRODUCTION: In recent years, utilization of 3D printing in medicine has increased. Different methods have been used for the development of 3D printed surgical instruments. However, limitations such as reliability and lack of reusability stop their adoption in operating rooms. Traditional surgical instruments are expensive, raising the question of whether 3D printed alternatives could offer a sustainable solution. Research on this topic can help reduce the financial burden on our institutions and provide a more affordable option for medical students and residents in training. Our study investigated the potential of using 3D printed instruments in the education of medical students and residents, in order to determine if these instruments can reduce costs and enhance access to training.

METHODS: We used Dassault Systems SolidWorks to design a Mayo-Hegar based needle holder and Adson based tissue forceps using plant-based biodegradable PLA and printed via an EOS EOSINT P 390 and a SOVOL SV01 PRO 3D printers. We included 62 medical students and 10 surgical residents, who trained on the "Module 3: Suturing" of the ACS/APDS Surgery Resident Skills Curriculum. Two groups were formed for the study: one group utilized traditional instruments, while the other group used 3D printed instruments. After completing each task, the results were evaluated based on time and errors.

RESULTS: The cost of producing the instruments amounted to 0.66USD/ needle holder and 0.32USD/forceps, with no functional difference and price between the 2 printers. The cost was significantly lower than the cost of traditional instruments. There was no significant difference between the 2 groups regarding the time and errors. No instruments failed during the tasks, but 9 failed upon further rigorous testing.

CONCLUSION: Further research in needed to evaluate the reliability of PLA surgical instruments. Regardless, their affordability and eco-friendliness makes them suitable for use in training of students and residents.

Poster #32

Development of a Low-Cost Surgical Stabilization of Rib Fracture Simulator: 3D-Printed Primer and Porcine Model

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INTRODUCTION: Surgical stabilization of rib fractures (SSRF) has become increasingly utilized in thoracic trauma, but hands-on experience is variable among General Surgery trainees. Currently, there are few published simulation models for SSRF. We developed a low-cost primer and SSRF model and analyzed its effectiveness to meet training objectives and to increase medical students' interest in Surgery.

METHODS: Two low-cost training models were developed for operative rib fixation. The first model was a 3D-printed rib cage, created using an edited open-source NIH 3D model and printed with a Prusa MK4 Printer. This served as an educational primer for the second model, which used porcine ribs and readily available materials. SSRF tools were provided by industry. Learning objectives included operative exposure, bone reduction, fracture stabilization and fixation. Assessment was surveyed on a Likert scale from medical students after demonstration (n=17).

RESULTS: The 3D-printed Rib Primer Model utilized open-source software, a makerspace workshop, and PLA filament. The estimated public cost is $20 per 3D model. The Porcine Thorax Model was constructed using porcine ribs, plastic boxes, faux leather, Swedish dishcloths, Coban wrap, and an operative rib fixation system. Total cost was $34 per model with a donated fixation system. After simulation, the majority of participants reported new knowledge of SSRF learning objectives. All 17 (100%) respondents reported somewhat or strongly learning stabilization and fixation while 16 (94%) reported somewhat or strongly learning exposure and 15 (88%) reported somewhat or strongly learning reduction. Sixteen students (94%) reported somewhat or strongly increased interest in Surgery as a career.

CONCLUSION: Low-cost SSRF models can be developed to teach key operative principles and increase interest in Surgery. Our 3D-printed Rib Primer Model provides learners with spatial understanding of exposure and reduction while the Porcine Thorax Model allows for hands-on stabilization and fixation.

Poster #33

Low-Cost Endovascular Simulation for Surgical Training

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INTRODUCTION: Medical simulators have emerged as a pivotal tool for medical training and skill enhancement. Studies have shown that an endovascular simulation can increase trainees' skills in all measures of performance. Existing commercially available endovascular simulators include the ANGIO Mentor (Simbionix, Cleveland, OH, USA), Vascular Intervention System Trainer (VIST) simulator (Mentice AB, Gothenburg, Sweden), and SimSuite (Medical Simulation Corporation, Denver, CO, USA) which all offer valuable learning experiences. However, such endovascular simulators come at a high cost. This high cost poses a significant barrier to widespread adoption, especially for smaller training centers.

METHODS: Our simulation tool leverages cost-effective strategies such as utilizing open-source software platforms to replicate image-guided endovascular therapy on low-cost hardware. Motions of the user will be tracked allowing the program to provide feedback for the user. We hypothesize that a simulator will shorten the learning curve for clinicians thereby enabling them to become more proficient more quickly.

RESULTS: From market analysis, it has been identified that there is a need for a low-cost endovascular simulation. The software simulation has been built with sample clinical scenarios complete with full camera rotation, guidewire navigation and anatomically accurate models.

CONCLUSION: The next steps are to perform preliminary surveys with current clinicians, fellows, and residents regarding the type of clinical scenarios necessary. Further study would be to measure our simulator's impact on learner's procedure skills.

Poster #34

Fundamentals of Microsurgery Skills: Preliminary Evaluation of Five Microsurgery Tasks

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INTRODUCTION: While there are many commercially available task trainers for microsurgery, they target limited skills- basic vessel suturing or vessel anastomoses. With the improvement of technique and surgical equipment, microsurgical procedures have become increasingly prevalent. While there has been increasing utility in the clinical setting, there remains a dearth of simulation-based curricula. To meet this need, we have developed a microsurgery training kit and evaluated the components' value.

METHODS: Simulator Development: The novel Fundamental Microsurgery Skills (FMS) kit was designed to support development of relevant skills via 5 different tasks commonly performed in microsurgery- vessel dilation, needle loading/transferring, suturing, coupling, and trimming. The compartmentalized kit contains a 3D-printed platform, unique working platforms for each task, and all the components for each task. Study: Four plastic surgeons, having a mean of 10 years' experience, evaluated the components of the FMS training kit using an 8-item paper survey to evaluate the characteristics of tasks, their value and relevance using 5-point scales (5=high). Review of ratings and comments were used to guide the development of the task trainer.

RESULTS: A table was created evaluating the mean of the components of the training kit.

CONCLUSION: Preliminary results support the use of the FMS. Future work will target an expanded test group including ENT, Orthopedic, OMFS and a larger pool of Plastic surgeons, and development of performance standards.

Poster #35

Simulating Serious Rare Complications from Endoscopy for Congenital Esophageal Stenosis

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INTRODUCTION: Esophageal perforation with bilateral tension pneumothoraxes (TPT) are rare, immediately life-threatening complications that occurred during attempted esophageal dilation and ventilation in a child, requiring urgent bilateral needle thoracostomies. We developed an infant-sized simulator to practice diagnosis of TPT and resuscitation.

METHODS: A thorax, tracheobronchial tree, esophagus, and diaphragm were 3D printed with rigid and flexible materials. Lungs, visceral pleura with defects, and parietal pleura were simulated by nesting balloons and sandwich bags clamped to the bronchi. Layers of connective tissue, muscle, fat, and skin were simulated using plastic wrap, and red, yellow, brown, and tan felt and EVA foam. Nipples were drawn at the 4th intercostal spaces.

RESULTS: Pediatric surgeons reviewed the simulator for face validity. The trachea was intubated and lungs ventilated with bilateral air leaks expanding the pleural spaces. Bilateral needle decompression was performed with 16G needles in the traditional anterior insertion site (2nd intercostal space midclavicular line) or alternative anterior insertion site (2nd intercostal space at the nipple line). The plastic wrap and inflated sandwich bags simulated a conclusive "pop" and rush of air with improved ventilation. Thoracostomy tubes could be placed and secured. It scored well for visual and palpable landmarks with good haptic feedback. Recommendations were to simulate pneumoperitoneum to also practice management of that potential complication. Improvements are forthcoming.

CONCLUSION: The pediatric simulator will be incorporated into an interprofessional, intraoperative simulation of esophageal endoscopy with resultant tension pneumothorax, cardiac arrest, and code blue with goals to improve response times and teamwork.

Poster #36

A Comparison of a Novel 3D-Printed Inguinal Hernia Simulator vs. Current Standard of Training

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INTRODUCTION: Surgeons perform over 800,000 inguinal hernia repairs (IHR) annually in the United States and this procedure is considered a milestone of general surgery training. However, early surgical trainees struggle with the anatomy of the inguinal canal and lack affordable surgical simulators for practice. To address this, we developed a 3D printed simulator (3DS) and performed a convergent mixed methods study comparing it to a porcine model.

METHODS: The 3DS was composed of silicone, fabric, and plastic; the porcine model is currently used to simulate IHR at our institution and is created from a pork side. Participants, PGY3 or above residents and faculty experts in either surgical simulation or IHR, evaluated the models with an adapted Michigan Standard Simulation Experience Scale and participated in semi-structured interviews. We compared the simulators using Cohen's D effect sizes and performed thematic analysis of interview transcripts informed by the quantitative results.

RESULTS: Participants included 6 residents, and 7 general surgery faculty, all completing the quantitative study, and 12 were interviewed. The 3DS demonstrated medium (>0.5) to large effect sizes (>0.8) on 6 of 8 criteria, with the greatest effect seen in pelvic anatomy and the lowest in mechanical properties and operating in small spaces. We identified three themes: 1. Role: trainees prioritized anatomy whereas faculty prioritized both anatomy and tissue fidelity 2. Cognitive Load: The 3DS realistically simulated procedure steps and could decrease intra-op cognitive load 3. Lack of Preparedness: current training is insufficient. All participants felt that the 3DS should be incorporated into future training.

CONCLUSION: Training needs for IHR are complex and require replication of accurate anatomic relationships to simulate the procedure. We found that our 3D printed simulator allowed for high fidelity replication of pertinent anatomy such that its lower mechanical fidelity does not preclude simulator usability.

Poster #37

The Michigan Elbow: Examining the Quality of a Pulled Elbow Task Trainer by Pediatric Specialists

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INTRODUCTION: Radial head subluxation, also known as pulled elbow or nursemaid's elbow, is a common injury in young children. Supination and pronation techniques, used to reduce the elbow, are not commonly taught outside clinical settings. The novel trainer, the Michigan Elbow, was designed to support learning of reduction techniques. Prior to implementing, evaluating the models' value across different specialties, where best practices and preferred reduction methods vary, is critical.

METHODS: Two models, supination and pronation, included a 3D-printed plastic mechanism embedded in a silicon-based child-size arm form. A mechanism provided an audible click and haptic feedback when the elbow is reduced.

Thirteen experienced pediatricians (P, n=13) and pediatric emergency physicians (PEM, n=8) independently evaluated both simulators' physical attributes, realism, value, and relevance using a 14-item paper survey consisting of 4-point rating scales (4=highest). Participants' reduction ability were self-reported using 5-point rating scales (5=very easy). Rating differences across specialties was tested using Kruskal-Wallis, with $p \leq 0.05$ being statistically significant and $\eta^2 \geq 0.5$ considered moderate effect.

RESULTS: Pediatric and PEM participants self-reported an average of 15.2 and 43.5 lifetime elbow reductions, respectively. Pediatricians reported no preference to a reduction technique (50% split), while 7 (87.5%) of PEM participants preferred pronation. For most items, ratings were consistent and positive leaning across specialties, with mean scores suggesting adequate physical attributes (M_P=3.35, SD=0.57 and M_{PEM}=3.20, SD=.42, p>0.05), but low realism of experience (M_P=2.96, SD=0.53 and M_{PEM}=2.73, SD=.89, p>0.05). PEM participants rated the simulator lower than pediatric participants for *scale* and f*eel of elbow when reduced*, ($p<0.05$, $\eta^2 \geq 0.14$). Suggestions included size reduction and improving haptics on reduction of model.

CONCLUSION: Preliminary findings indicate the simulator holds promise for training after refinement. Difference in preferred reduction methods may have influenced ratings, but sample size was limiting. Future research targets model refinement and deeper examination of preferred techniques.

Poster #38

AI-JiMi Abdomen Hemorrhage: An AI Wearable Augmented Reality E-Trainer to Instruct and Evaluate General Surgery Physician Assistants' Competency During Prolonged Field Care in the Management of Non-Compressible Abdominal Hemorrhage in Austere Environments

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INTRODUCTION: Prehospital noncompressible torso hemorrhage results in an 85.5% mortality rate, with 75% of deaths occurring before patients reach a definitive care facility. Most casualties with non-compressible abdominal hemorrhage (NCAH) will succumb to death within 30 minutes. Hence, it is crucial to provide effective training for both surgical and nonsurgical prolonged casualty care (PCC) providers in order to reduce mortality rates from preventable causes of death in austere environments, particularly during prolonged evacuations lasting 6 to 24 hours. To address this problem, the artificial intelligent (AI) enabled Juxtopia®Context-Aware Mobile Mixed Reality Assistive Device (CAMMRAD) Augmented Reality (AR) system shall apply empirically researched preliminary study results to improve human cognitive & psychomotor clinical skills of general surgical physician assistants (GSPA), deployed far-forward, to manage NCAH.

METHODS: U.S. Army military 68Ws and a general surgical physician assistant (GSPA) responds to a simulated mass PCC care under fire (CUF) incident in a multistory building. The GSPA wears the Juxtopia®Context-Aware Mobile Mixed Reality Assistive Device (CAMMRAD) Augmented Reality (AR) while the AI Juxtopia Intelligent Medical Instructor (JiMi) e-trains and e-evaluate GSPA's psychomotor clinical skill proficiency.

RESULTS: In related AI enabled Juxtopia® CAMMRAD Medic e-training research, respondents using the Juxtopia® AI e-trainer (experiment group), "JiMi", and non-AI e-trainer (control group) agreed that the AI e-trainer conversational speech was clear and easy to understand (M=1.4, SD=.843). Participants were neutral in response to e-trainer assisting in identifying incorrect skills (M=3.0, SD=1.25) and agreed somewhat to evaluating skills performed (M=2.5, SD=1.35). Participants agreed that the AI e-trainer reduced the need for additional trainers (M=2.3, SD=1.06); and improved hands-on skill proficiency (M=2.2, SD=1.03).

CONCLUSION: The AI-JiMi e-trainer has the potential to deliver a more personalized, mobile and adaptive PCC e-learning intervention for general surgical physician assistants (GSPA).

Poster #39

Development of a Training Simulator for the Digital Rectal Exam

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INTRODUCTION: Dyssynergic defecation is the cause of nearly 25% of chronic constipation cases. Although treatable, diagnosis of the condition is unreliable due to difficulty in describing the sensation of sphincter muscle action to students learning the procedure. There is a clear need to provide realistic and consistent feedback to learners in training. We have designed a dynamic simulator for the digital rectal exam (DRE) to better train physicians in diagnosing dyssynergic defecation.

METHODS: A physical model of the human rectal anatomy was built using 3D printing and off-the-shelf microelectronics. The sphincter muscle was simulated using an automated pneumatic circuit including a pressure cuff, pump, and solenoid valve. The puborectalis muscle action was mimicked using a linear actuator. An anorectal manommetry (ARM) catheter was used to evaluate the simulated sphincter muscle with real ARM pressures. Five physicians who are experts in the DRE were invited to provide feedback using a 5-point scale (1 = lowest; 5 = highest) on the realism of feel from the simulated external sphincter muscle and puborectalis muscle.

RESULTS: Testing with the ARM catheter confirmed the accuracy of the simulated pressures. Bearing down pressure was measured at 15 mmHg, resting pressure at 50 mmHg, and contraction pressure at 150 mmHg. Expert feedback indicated that the feel and function of the simulator was similar to what would be expected in a real DRE exam, establishing the face and content validity of the training simulator. The mean rating for realism was 4.04 +/- 0.76, 4.13 +/- 1.02, and 4.25 +/- 0.49 for the external sphincter muscle, puborectalis muscle and ergonomics, respectively.

CONCLUSION: The next steps will be to establish concurrent and divergent validity of the training simulator for the DRE with medical students and residents.

Poster #40

Decreasing Discrepancy between Pre-Flip and Post-Flip Electromyography Data in Spinal Surgery

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INTRODUCTION: Electromyography (EMG) is an intraoperative monitoring modality used during spinal surgeries to provide information on the function of muscles and nerves that innervate them. Many spinal surgery cases require "pre-flip" baseline measurements, taken of muscles while the patient is supine. After flipping the patient to a prone position, baseline measurements of muscle function are repeated ("post-flip"). This increases the time before a case begins due to time spent disconnecting and reconnecting the EMG leads between pre-flip and post-flip measurements. The many wires can lead to error in placement of EMG leads after flipping the patient and increased variability between measurements. To reduce the likelihood of error, our team has proposed a novel, low-cost device that will reduce the time to incision in the operating room and decrease discrepancies between pre-flip and post-flip measurements.

METHODS: Our team designed a small, wireless server and receiver device that connects with existing intraoperative monitoring systems through adapters. The server connects to the leads of the monitoring system that connects to the patient, and the receiver connects to the intraoperative monitoring system across the room. The device provides information regarding connection and data transmission status to the user using a display module.

RESULTS: Server and client codes were written. Preliminary testing of the data transmission capability proved successful, demonstrating the potential effectiveness for transmitting intraoperative nerve monitoring data wirelessly. Preliminary reflected binary code transmission testing showed minimal to no data drops when transmitting across our wireless system, demonstrating reliability of our device in a controlled environment.

CONCLUSION: Future testing will include expanding the capabilities of data transmission to ensure our device functions at the same level as current technologies and reliability testing in the OR to ensure optimal capability in an electromagnetic-prone environment. All future prototypes will be subject to animal and human testing.

Poster #41

A Versatile Simulator for Liver Transplant Implantation Techniques

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INTRODUCTION: There are several approaches to control the vena cava during hepatectomy and implantation in liver transplantation. It is critical for transplant surgeons to efficiently determine when to employ varying methods to execute liver graft implantation. Due to the nature of the operative field, the needle angulation and trajectory is unique to this operation. Given the physiologic strain on the recipient during vena caval occlusion and the potential for injury to the graft with prolonged implantation time, it is challenging to discuss nuances of decision-making and provide real-time feedback during this portion of the procedure.

To develop this knowledge and skill set removed from time pressures, we created this simulator. The model is unique in its versatility, allowing for simulation of all approaches to liver implantation.

METHODS: Our model utilizes one plastic box and roughly molded ballistics gel liver to represent the liver within the peritoneal cavity. Penrose drains represent the vena cava. The molded liver can be used indefinitely, and the drains are exchanged for repeated practice. Instruments retired from the OR were utilized. We used discarded or grant-provided suture. The cost for fabrication of reusable components is approximately $100.

The two-hour session includes a brief discussion of indications, anatomy, and anastomotic techniques. The remaining time is dedicated to simulating various techniques, with an emphasis on clamp placement and anastomosis set up.

RESULTS: Challenges to data collection include the need for a multi-institution study due to single center trainee volumes.

CONCLUSION: Our simulator replicates all methods of caval clamping and liver implantation, allowing a means to familiarize trainees with a technically and physiologically challenging aspect of liver transplantation. Goals for future study include understanding the impact on trainees' comprehension of techniques as well as comfort and efficiency with execution.

Poster #44

Lower Limb Vascular Access and Endovascular Skills Enhancing Cadaveric Training Course

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INTRODUCTION: Lower limb amputation due to peripheral arterial disease (PAD) remains a significant global health challenge, as advanced PAD often results in the need for such a drastic surgical intervention. The five-year mortality rate post-major amputation can reach up to 50%. Endovascular techniques provide minimally invasive solutions that can reduce the need for amputations, underscoring the importance of practical resident training. We present a cadaver leg model designed for comprehensive training to enhance residents' technical skills to combat severe vascular conditions.

METHODS: Eight cadaveric legs, selected based on a high likelihood of advanced arterial atherosclerosis through reviews of donors' medical histories, comorbidities, and causes of death, were prepared at the Methodist Institute for Technology, Innovation, and Education (MITIE). The common femoral artery (CFA) was connected to a pulsatile pump. Eight residents, from PGY1 to PGY5, inserted 5 to 7 French sheaths into pedal arteries, completing a closed circuit that allowed saline to return to the reservoir via suction. Doppler ultrasound and fluoroscopy-guided angiography were employed for guidance.

RESULTS: The model successfully replicated realistic scenarios for residents to practice various arterial lower limb procedures, including pedal access and closed-circuit creation. Using Doppler ultrasound and angiography, residents gained experience in crossing chronic retrograde and anterograde total occlusions (CTOs). They also practiced deploying stents, conducting balloon angioplasties, performing atherectomies, thrombectomies, embolization, and bypass grafting. Participants reported enhanced confidence and significant improvements in technical skills across endovascular techniques post-training.

CONCLUSION: The cadaver leg model with a pulsatile pump proved an effective and reproducible training tool, equipping residents with the skills to reduce limb amputation rates and enhance patient care in vascular surgery.

Meet the Authors Poster Session

Teaching Methods, Posters 42, 43, 45-58

Poster #42

Simulation "Office Hours" for Trainees

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INTRODUCTION: Junior trainees are often on the periphery of the technical performance of surgery, yet they are pushed to decide on a career trajectory which is dependent on whether they enjoy the practice or can see themselves within the practice. Simulation allows trainees to better experience the technical aspects of the field in a low stakes' environment. By attempting skills, they may appreciate the satisfaction and challenges in execution that can be lost through simply observing surgeries. Further, as they improve their skills through repetition with guidance, it may reinforce that skill is developed through practice versus innate ability. On our transplant service, it is difficult to provide "hands on" exposure for students and junior residents. This presents a need to create opportunities for junior trainees to experience the technical exercise of surgery and the nature of skill development.

METHODS: Beginning in fall 2023, we piloted a two-hour surgical simulation every other week. The senior author led all sessions with trainees on service. While the stations were transplant specific, the focus was adjusted to meet the needs of the trainee level, ranging from knot tying to graft implantation. A technical or anatomical concept may be briefly discussed; however, the primary goal was to allow trainees to use their hands, understand and practice surgical techniques.

RESULTS: In this flexible set up, trainees were consistently engaged in practice. While optional, it was well attended by trainees (average 3-5/session). Future work includes exploring the impact on trainees' impressions of surgery, understanding of techniques, or mindset regarding acquiring skill. Given the mixed complement of the trainees, the varying focus and the overall low volumes, it is difficult to find a unifying metric to assess impact.

CONCLUSION: Trainee targeted simulation sessions consistently engaged learners from a variety of levels to the technical experience of surgery.

Poster #43

Lower Limb Venous Access and Endovascular Procedures Simulation Training Course

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INTRODUCTION: Chronic venous disease (CVD) is a common condition affecting the veins in the lower limbs, ranging from minor cosmetic concerns to serious conditions, like deep vein thrombosis (DVT) and chronic venous insufficiency (CVI). CVD affects approximately 1 in 20 adults and is more prevalent in women. Proper management requires precise venous access and advanced endovascular techniques to protect venous valves and maintain venous function. We developed a cadaveric venous model to enhance resident training in venous access and endovascular procedures, offering a realistic, controlled environment to improve their skills.

METHODS: The simulation used ten cadaveric legs prepared at the Methodist Institute for Technology, Innovation, and Education (MITIE), selected based on donor histories of venous disease. A continuous pump filled the venous system with saline via the femoral vein, aiding ultrasound localization. Eight residents (PGY1 to PGY5) accessed the superficial veins of the foot, performing venography to evaluate valve function and venous anatomy. The residents practiced procedures like mechanical thrombectomy, radiofrequency ablation, sclerotherapy, endovenous laser therapy, thrombolysis, balloon angioplasty, stenting, and coiling.

RESULTS: Venography showed the difficulty of contrast only reaching up to the knee due to valve function. The model effectively simulated the complexities of venous access, allowing residents to practice a range of techniques and navigate challenging venous anatomy. Residents reported increased confidence and significant improvements in their technical skills after training.

CONCLUSION: This work is currently being prepared for a scholarly article, where we will provide a more detailed analysis of the methodologies, outcomes, and implications for future vascular surgery training. We believe that this article will contribute to the advancement of endovascular education and ultimately improve patient outcomes in the management of chronic venous disease.

Poster #45

Embracing the Future of Trauma Simulation: Manikins Lead the Way—No Need to Fear the Transition. Insights from a Comparative Study of Trainee and Trainer Perspectives in Ecuador's ATLS Programs

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INTRODUCTION: As trauma education evolves globally, high-fidelity manikins have increasingly replaced cadaveric animal models for simulation. However, this transition remains controversial, particularly in developing countries. This study explores the perceptions of trainees and trainers in Ecuador, regarding the quality, fidelity, safety, and realism of manikin-based trauma simulations.

METHODS: Surveys were conducted among 103 trainees and 42 trainers after the completion of ATLS training course in Ecuador from November 2022 to December 2023. Participants rated cervical, thoracic, and abdominal manikins on quality, fidelity, safety, and realism using a Likert scale (1=worst, 5=best), with a rubric for consistency. Perceptions of the use of cadaveric animal models and recommendations for future training methods were also assessed. Statistical analysis was performed using IBM SPSS, with chi-square tests evaluating independence among variables and a correspondence analysis comparing alignment between participant groups.

RESULTS: Both trainees and trainers consistently rated manikin attributes highly, with no significant differences ($p > 0.05$) between groups across quality, fidelity, safety, and realism, indicating strong consensus. Correspondence analysis further confirmed alignment in perceptions, demonstrating cohesive support for the transition to manikins. Additionally, independence analysis demonstrated that the surveyed groups had no influence on each other, nor were they biased by external factors in their responses and were consistent with the idea of transition.

CONCLUSION: In conclusion, this study underscores the efficacy and acceptability of high-fidelity manikins in simulation for ATLS training within a developing-country context. The transition from cadaveric animals to manikins in Ecuador has preserved simulation quality while addressing ethical and logistical challenges. These findings support broader adoption of simulation-based trauma training globally, paving the way for studies that demonstrate manikin-trained professionals are well-prepared to manage real-world trauma scenarios without compromising patient outcomes.

Poster #46

Immersive Virtual Reality Simulation for Technical Skills Acquisition in Pneumothorax Management and Chest Tube Insertion: A Randomized Controlled Trial Among Surgery Interns

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INTRODUCTION: Traditional methods of teaching surgical skills, such as classroom didactics, often lack interactivity and standardization. Immersive virtual reality (IVR) may offer a novel, engaging approach to enhance technical skills training. This study assesses the efficacy of IVR simulation for technical skills acquisition in pneumothorax management and chest tube insertion (CTI) among incoming first-year surgery residents.

METHODS: Utilizing Unity software engine, a novel IVR module on pneumothorax management and CTI was developed on a head-mounted display by a multidisciplinary team of surgeon-educators and software engineers. Forty-five surgery interns with no previous clinical exposure to CTI were recruited at a tertiary care academic center in Philadelphia, Pennsylvania, US and were randomly assigned (1:1) to receive instruction via IVR (n=21, 47%) or traditional classroom didactics (n=24, 53%). Technical skill acquisition was measured via performance on a previously validated ten-item Objective Structured Assessment of Technical Skills (OSATS) evaluation.

RESULTS: The IVR group outperformed the control group in the total mean OSATS score (39.8 ± 4.4 vs 36.7 ± 2.9, p=0.009). Compared to control, the IVR group showed significant higher mean scores in blunt dissection on the top side of the rib (4.14 ± 0.48 vs 3.79 ± 0.59, p=0.035), economy of time and motion (3.71 ± 0.72 vs 3.21 ± 0.51, p=0.018), and amount of help needed from tutor (4.0 ± 0.89 vs 3.33 ± 0.70, p=0.008).

CONCLUSION: IVR demonstrated substantially improved technical skills acquisition in CTI over traditional learning modalities in surgery interns. These findings support potential broader implementation of IVR in surgical education.

Poster #47

"Inventor, Investor, Surgeon": An Experiential Vehicle to Engage Medical Students in Innovation in Medicine from Inception to Implementation

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INTRODUCTION: Innovation is a critically important concept, often overlooked in traditional didactic lecture-based medical school curricula, that drives medical breakthroughs by identifying clinical needs, gaps in knowledge, and emerging technologies to improve patient care. We developed a novel cardiovascular-focused experiential program, "Inventor, Investor, Surgeon" (IIS), as a vehicle for immersive learning of biomedical innovation.

METHODS: IIS participants first reviewed cardiac physiology and critiqued cardiac devices (LVADs, valves) before being divided into teams of three. Each team member then adopted a role: Inventor selects a device, presents their design and rationale, and makes a convincing pitch to the Investor; Investor uses entrepreneurial skills to determine whether to fund the device and champion its use to the Surgeon; Surgeon weighs efficacy, clinical applications, and risk-benefits for their patients. In continuation, students then participated in hands-on surgical skills labs, meeting with industry representatives and implanting devices in pig hearts under the mentorship of cardiac surgeons. Students completed programmatic evaluations (1-poor; 5-excellent) and provided feedback. Data are presented as percentages.

RESULTS: First- and second-year medical students voluntarily participated in our IIS program (n=106 evaluations), embracing the unique role-play activities and engaging in highly animated discussions with their peers, mentors, and industry representatives during these extraordinary surgical training opportunities. Data demonstrated 100% of participants valued the innovative educational experience as "5-excellent" or "4-very good" and 100% reported their knowledge and skills improved. Written feedback included enjoying the fun, hands-on, educational aspects, regardless of background or medical specialty interest.

CONCLUSION: Our IIS program integrates creativity, design, and entrepreneurial skills into effective applied clinical critical thinking with hands-on experiences. Engaging medical students in biomedical innovation early in their training and encouraging them to share fresh, unbiased critiques and creative ideas offers tremendous multidisciplinary value with added benefits of low-cost, reproducibility, and high translatability to all medical specialties.

Poster #48

Multimodal, Student-Driven Surgical Education at a Primary Care-Focused Medical School

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INTRODUCTION: Medical schools' goal of producing more primary care physicians may come at a cost to early surgical exposure. Our tier-1 primary care institution has experienced a progressive decline in surgical match rate (22.7% 2022, 12.7% 2023, 16.3% 2024). Preclinical exposure to surgical skills training is valuable in promoting clerkship readiness and developing interest in surgery. We sought to determine if regular extra-curricular instruction of surgical skills increased students' preparedness for surgical clerkships and interest in surgery at a primary care-focused medical school.

METHODS: Pre-Clerkship surgical education sessions were organized by the General Surgery interest group and supervised by general surgeons. Sessions included weekly extra-circular education and knot-tying with supplemental evening surgical skills workshops. Students were surveyed to assess effectiveness of skills training, interest in surgery, and preparedness for surgical clerkship.

RESULTS: Surveys across 2 skills events yielded 22/30 (73.3%) responses indicating "interested" or "very interested" in pursuing a surgical specialty. 28/30 (93.3%) responses reported these events increased their preparedness for clerkships. 17/17 (100%) respondents in the second skills event indicated increased interest in a surgical career.

15 surveys were collected from weekly knot-tying sessions. With 1, 2, 3, 4, or 6 total sessions completed, respondents reported mean confidence of 1.67, 1.60, 3.00, 3.00, and 2.00, respectively (n = 6, 5, 1, 1, 2). 14/15 (93.3%) responses indicated interest in a surgical specialty.

CONCLUSION: We demonstrate a method of regular and intermittent student-led surgical education that generates participant-identified improvements in surgical skills, interest in surgery as a career, and preparedness for surgical clerkships. These findings provide a model for similarly primary care-focused institutions where there exists a need for supplementation of pre-clerkship surgical education.

Poster #49

Beyond Technical Proficiency: Escape Rooms as Tools for Developing Interpersonal Skills in Trauma Management

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INTRODUCTION: Teaching trauma-related emergencies presents a significant challenge in medical education, given the need for rapid and accurate application of theoretical knowledge in practical scenarios. The medical practice environment in emergency units demands not only technical competencies but also interpersonal skills or soft skills, such as leadership, effective communication, and teamwork, which are crucial for the appropriate management of critical situations. Gamification, specifically through the use of "Escape Rooms" (ER), emerges as an innovative approach, providing a simulated environment that mirrors the real challenges faced in emergency situations. This study aims to implement ER with medical students to evaluate the impact on the acquisition and enhancement of soft skills in Advanced Trauma Life Support (ATLS).

METHODS: This is an observational, prospective study, approved by the Ethics Committee, utilizing the TEAM scale to assess the impact of ER.

RESULTS: Thirty-three students participated, predominantly female (61%), with a mean age of 23 years. The overall TEAM scale score (pTEAM) indicated a positive evaluation of team skills, with a mean of 37.67 (SD = 3.77). Notably, the relationship between pTEAM and Teamwork shows a strong positive correlation in the general sample ($r=0.732$, $p<0.001$), indicating that higher overall performance is consistently associated with better teamwork across all game configurations. In contrast, the correlation between pTEAM and Leadership is less consistent, showing a moderately high correlation ($r=0.528$, $p=0.360$) but without statistical significance.

CONCLUSION: ER proved to be an effective strategy for enhancing soft skills in traumatic emergencies. The results highlight the value of ER as an educational tool for developing critical interpersonal skills in high-pressure environments, thus contributing to a more holistic medical education that is better prepared for practical challenges.

Poster #50

From Classroom to Crisis: Assessing Escape Rooms as a Tool for Advanced Trauma Life Support Skill Development

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INTRODUCTION: The teaching-learning process in Advanced Trauma Life Support is crucial in medical education. In this context, the use of innovative teaching methodologies such as the "Escape Room" (ER) has emerged as a promising strategy by offering hybrid scenarios that combine game mechanics with realistic simulation techniques, allowing students to practically apply theoretical knowledge in a controlled and playful environment. This study aims to evaluate the impact of using "Escape Room" as a teaching strategy in Advanced Trauma Life Support (ATLS) among medical students.

METHODS: This is a randomized, controlled study, approved by the IRB. Fourth-year medical students were eligible to participate in the activity. The primary outcome was academic performance obtained in pre- and post-intervention assessments, and secondary outcomes were satisfaction and self-confidence with teaching as measured by the Student Satisfaction and Self-Confidence in Learning scale.

RESULTS: 66 students participated, divided into 2 groups, over 2 ER sessions. The majority were female (60.8%), with a mean age of 22 years, and 56.5% of participants did not habitually engage in non-sports games. Participants reported high levels of satisfaction and self-confidence, reflecting a positive perception of the efficacy and relevance of the applied methodology. There was a significant increase in the number of correct answers, with the mean pre-intervention score rising from 7.33 (SD = 1.71) to 8.22 (SD = 1.17) post-intervention, with a p-value = 0.036.

CONCLUSION: ER proved to be an effective strategy for teaching ATLS among medical students. This analysis highlights the value of ER as an educational tool for developing critical interpersonal skills in high-pressure environments.

Poster #51

Enhancing Advanced Life Support Education: A Randomized Controlled Trial of Escape Room Methodology in Medical Training

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INTRODUCTION: Topics related to Advanced Life Support are fundamental in medical education. In this context, the use of innovative teaching methodologies such as the "Escape Room" (ER) offers hybrid scenarios that combine game mechanics with realistic simulation techniques, allowing students to practically apply theoretical knowledge in a controlled and engaging environment.

METHODS: This randomized, controlled study was approved by the Ethics Committee. The primary outcome was academic performance, measured through pre- and post-intervention assessments. Secondary outcomes included satisfaction and self-confidence in learning, evaluated using the Brazilian Portuguese validated version of the Student Satisfaction and Self-Confidence in Learning scale, administered before the final debriefing.

RESULTS: Sixty-six fourth-year medical students participated, with a majority being female (60.8%), a mean age of 22 years, and 56.5% reporting no regular engagement in non-sports games. There was a significant increase in correct answers, with the pre-intervention mean score of 6.91 (SD = 1.63) improving to 7.85 (SD = 1.18) post-intervention ($p = 0.0013$). Subgroup analyses yielded equally promising results. In the ACLS group, the mean score increased from 6.40 (SD = 1.40) to 7.40 (SD = 1.06) ($p = 0.0252$). The ATLS group showed improvement from a pre-intervention mean of 7.33 (SD = 1.71) to 8.22 (SD = 1.17) post-intervention ($p = 0.036$). Moderate positive correlations were observed between age and various questions, indicating a more favorable perception among older participants. No significant gender-based differences were noted, suggesting the methodology was well-received across all participants.

CONCLUSION: Escape room proved to be an effective teaching methodology in advanced life support, significantly enhancing learning and knowledge retention, as well as improving satisfaction and self-confidence among medical students. These findings underscore the need for innovation in teaching methodologies to meet student expectations and needs.

Poster #52

Assessing the Impact of Resident-Led Simulation Education in Surgical Clerkship: A Comprehensive Study

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INTRODUCTION: Simulation-based education has become crucial in medical training, offering immersive learning experiences. This study explores the impact of transitioning from faculty-led to resident-led simulation education within the surgical clerkship, focusing on three critical dimensions: perceived effectiveness of resident-led simulations, teaching skills development among surgery residents, and medical student satisfaction and engagement.

METHODS: Objective 1: Perceived Effectiveness of Resident-Led Simulations. Medical students' perceptions of the effectiveness of simulation sessions led by surgery residents will be assessed through a survey to gauge students' views on the clarity of learning objectives, realism of scenarios, application of clinical concepts, enhancement of critical thinking skills, engagement level, confidence building, and the effectiveness of feedback and debriefing. Objective 2: Development of Teaching Skills Among Surgery Residents. Mixed-methods approach will be employed to evaluate the development of teaching skills among residents. Residents will complete a self-assessment survey, providing insights into their communication, adaptation to diverse learning needs, receipt of constructive feedback, effective use of simulation technology, scenario creation, engagement of students, and overall confidence in their role as simulation educators. Qualitative data will be gathered through interviews and focus groups. Objective 3: Medical Student Satisfaction and Engagement. Satisfaction survey will be administered to students, focusing on educational value, clarity of instruction, engagement level, relevance of scenarios, interaction with residents, and overall satisfaction. Open-ended questions will allow students to provide additional comments and suggestions.

RESULTS: Data and qualitative insights will be analyzed to understand medical students' perceptions of resident-led simulations, residents' self-assessment of teaching skills development, and medical student satisfaction with simulation sessions. Findings will provide a comprehensive view of resident-led simulation education's impact.

CONCLUSION: This research offers insights into surgical clerkship education, highlighting the effectiveness of resident-led simulations, acknowledging the importance of simulation in medical education and informing improvements in teaching practices among surgery residents.

Poster #53

Low-Fidelity Suturing Models Are Equally as Effective as Human Cadaver Tissue for Early Suture Training

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INTRODUCTION: Simulation allows medical students to reap the benefits of hands-on learning before entering the clinical setting. However, the relative effectiveness of low-fidelity models and human cadavers in early suture training, particularly in fostering student confidence in their ability to apply sutures to real patients, is unclear.

METHODS: Separate suturing sessions were held in our institution's human cadaver lab and in a skills lab with low-fidelity vinyl model arms. The 1.5-hour sessions were facilitated by the same surgical resident and began with a 20-minute presentation discussing suturing techniques followed by a demonstration. Students then practiced simple interrupted and simple running suture techniques. Pre- and post-surveys were administered to assess student's confidence and perceived suturing abilities.

RESULTS: 50 students in the model arm group and 33 in the cadaver group completed the pre- and post-surveys. Students in both groups reported a significant improvement in their ability to handle instruments, instrument tie, and perform simple interrupted and simple running suturing techniques following the session ($p < .001$). Students in both the model arm and cadaver group reported a significant increase in confidence in their ability to apply sutures to a real patient with supervision ($p < .001$). However, there was no difference in the magnitude of increased confidence between the model arm and cadaver groups.

CONCLUSION: Simulation suture training significantly improved perceived suturing ability following a single session. Both groups reported significantly increased confidence in their ability to apply sutures to real patients. Utilizing human cadaver tissue over models did not appear to provide subjective benefit, although future studies should include a more objective measure of skill acquisition. Students who are more confident in their ability to apply sutures to real patients, having never done so, may be more inclined to seek out such learning opportunities in their clinical rotations.

Poster #54

The Hunter's House: A Virtual Reality Memory Palace for Surgical Education

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INTRODUCTION: The traditional apprenticeship model of surgical education, where patients often bear the burden of the learning curve, is evolving with the ABS' Entrustable Professional Activities. This competency-based assessment framework demands instructional methods that can help guide trainees through critical competency milestones before they enter the operating room. Virtual reality (VR) simulation has proven to be a safe, on-demand learning tool to enhance surgical skills. The VR memory palace, a mnemonic technique that harnesses imagined environments to foster connections between information and loci, has been used to achieve improved knowledge retrieval and retainment compared to conventional text- and screen-based learning experiences in various high-level cognitive domains. This project aims to develop a VR memory palace to help general surgery residents learn the essential instruments and procedural steps of the laparoscopic cholecystectomy. Using VR memory palaces to teach general surgical principles, we hope to enable trainees to achieve competency milestones faster than traditional learning resources.

METHODS: The VR memory palace was developed to be an immersive in-house walkthrough, where each room represents the steps of a laparoscopic cholecystectomy. Surgical instruments were mapped to distinct objects in the house to facilitate information recall. A pre-test and post-test system was designed to measure general surgery residents' ability to describe the basic steps of the operation (EPA #10: Evaluation and Management of a Patient with Gallbladder Disease) before and after exploring the VR environment. We are gathering Kirkpatrick level 1 and 2 evidence to compare the usability and efficacy of the VR memory palace to traditional methods for learning the instruments and procedural steps of a laparoscopic cholecystectomy.

RESULTS: The results will be analyzed to determine how well VR memory palaces support surgical education.

CONCLUSION: The findings will guide further development of the tool and its potential application to other general surgery procedures.

Poster #55

Improving Cadaver Selection for Surgical Training: Training Non-Clinicians in Point-of-Care Ultrasound (POCUS)

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INTRODUCTION: Cadaveric hands-on training is the gold standard for surgical training, providing a safe environment and reducing the learning curve. A key challenge for simulation centers is the lack of standardized cadaver screening, particularly for intact female genitourinary anatomy. This can lead to improper choice of cadaver for training. A recent study showed the potential of handheld ultrasound - point of care ultrasound (POCUS) in identifying body systems in cadavers, though it did not identify the uterus. Confirmation tests include costly CT scans or laparoscopy. We hypothesize that POCUS can more accurately identify a uterus in cadavers with saline injection into the urinary bladder. Additionally, we aim to determine if non-clinicians can be trained to correctly obtain ultrasound images of a uterus in cadavers. These identified cadavers would therefore be best utilized for specific gynecologic training.

METHODS: This study received IRB exemption. Hands-on POCUS training was provided to non-clinicians through didactic and hands-on training. Ultrasound image videos captured by non-clinicians were reviewed by three independent, blinded experts. The images were recorded in horizontal and sagittal orientation. The accuracy of each reviewer was assessed by the percentage of correct identification.

RESULTS: Five cadavers were evaluated by non-clinicians. Video clips were obtained with views of the uterus per non-clinician judgment and then reviewed by the expert panel. There was an overall agreement of 80% between the non-clinician and the expert panel.

CONCLUSION: In our small pilot study, we demonstrated that non-clinicians could be trained in POCUS specific to pelvic organ identification. The subsequent images were confirmed satisfactory by three experts. Donated specimens are an invaluable gift for medical education. Proper identification and characterization can allow directed training that values this gift. Future plans include further cadaveric identification to assist with placing proper cadavers in specific training.

Poster #56

Surgical Skills on the Podium: Assessing the Impact of Competitive Simulation

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INTRODUCTION: Simulation-based learning has become a key adjunct to surgical training, enhancing resident technical skills. However, its impact on resident morale and wellness remains understudied. This study evaluates resident satisfaction with a Surgical Olympics competition-based simulation event.

METHODS: A retrospective analysis was conducted among general surgery residents participating in an annual Surgical Olympics event over three years at a single institution. The event consisted of two 2-hour sessions (one open and one laparoscopic) held annually. Awards and video highlights were presented at the residency graduation ceremony. A 15-question survey assessed satisfaction with individual tasks and the overall event using 5-point Likert scales (1=very unsatisfied, 5=very satisfied). Statements on enjoyment, morale, and competitive environment were evaluated similarly (1=strongly disagree, 5=strongly agree). Descriptive statistics were computed to characterize the sample and evaluate satisfaction of the event. Fisher exact test was used for statistical analysis.

RESULTS: Of 27 eligible residents (active and graduated residents), 13 completed the survey (median age 34; 7 females, 6 males). Nine residents had successfully completed FLS before participation. Participants reported high satisfaction with the Surgical Olympics, with mean satisfaction scores ranging from 4.31 to 4.54 out of 5 for various aspects. They strongly agreed that the event was enjoyable (mean 4.31/5), improved residency morale (mean 4.54/5), and fostered healthy competition (mean 4.23/5). Eight residents (61.5%) preferred open tasks over laparoscopic, with no significant relationship to prior successful FLS completion ($p = 1$).

CONCLUSION: Participants across all PGY levels indicated high satisfaction with the Surgical Olympics event. This study suggests that competition-based simulation can enhance wellness and satisfaction during general surgery residency training. Future research should explore improvements in technical abilities and resident confidence in open and laparoscopic skills through such events.

Poster #57

An Escape Room to Consolidate the ACS/APDS Phase 1 Curriculum for Multidisciplinary Surgical Interns

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INTRODUCTION: The American College of Surgeons/Association of Program Directors (ACS/APDS) Phase 1 curriculum provides a framework to prepare surgical interns with the skills for effective clinical practice. For learners to incorporate this knowledge into behaviors, analysis, synthesis and evaluation are crucial. An escape room provides a simulated environment in which learners can progress to the higher levels of Bloom's taxonomy, working as a team. We describe the development and implementation of an escape room as a consolidation activity delivered at the end of the ACS/APDS Phase 1 local curriculum for our multidisciplinary surgery interns.

METHODS: Preceptored by a surgical faculty member with simulation education expertise, two 3rd year medical students developed an escape room activity. The students worked through a workshop-structured process utilizing an escape room development template to create the educational event. A theme for the escape room was chosen and puzzles created, based on Phase 1 module content.

RESULTS: The escape room will occur on 1 October 2024, at the conclusion of our local Phase 1 curriculum. Results regarding success of the team escaping the room, time taken to escape, puzzle solving and intern evaluation of the event will be presented. We will also present long term data from six month follow up, regarding the utility of the event in preparing interns for daily clinical life. Data from evaluation of the escape room creation process from the 3rd year medical students will also be presented, including utility to prepare them for surgical residency application and internship.

CONCLUSION: This ACSAPDS Phase 1 escape room could provide a useful adjunct to locally delivered curricula. Only 30% of programs deliver Phase 1 content nationally, and this work provides a template for gamification to consolidate the curriculum, with a goal of increasing learner and faculty engagement, and increasing knowledge and skill retention.

Poster #58

Exploring Muscles of Facial Expression with Virtual Reality

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INTRODUCTION: Facial anatomy, an essential component of medical education, is foundational for various surgical specialties such as ophthalmology, otolaryngology, and plastic surgery. However, there remains limited accessible educational resources that offer facial anatomical instruction through the unique lens of virtual reality (VR). In our work, we created a video that walks the user through VR animations illustrating the structure and function of muscles corresponding to facial expressions. The ability of video format to be easily disseminated eliminates the need for the impractical high costs of purchasing each student a headset while still providing the educational value and 3-dimensional view of VR.

METHODS: We utilized the Meta Quest VR headset and 3D Organon XR Anatomy application for video production. The VR display within the headset was cast to an external device, recorded, and collected for editing.

RESULTS: Some examples of facial expressions depicted in the video include eye blinking, blowing out cheeks, kissing, frowning, and pouting. For each expression, each of the facial muscles involved are displayed in two formats. The first is a static view of the muscle in relation to the position of other facial muscles and the second is an isolated, dynamic illustration of muscle movement. To keep the viewer engaged, we provided movie scenes, such as from Spiderman and Mrs. Doubtfire, as examples of facial expressions alongside the VR animation.

CONCLUSION: Current work entails gathering feedback through Likert scale surveys on the video's educational value from students at our medical school and writing surgical cases that assess the learner's understanding of facial anatomy and function. The next step is writing these results into a manuscript for publication. The intent of our work is to inspire further integration of VR in medical education and continued video production for other anatomical regions even beyond the face.